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TURIN CONVENTION OF INTERNATIONAL ELECTROTECHNICAL COMMISSION.

As previously noted in these columns, a convention of the International Electrotechnical Commission will be held at Turin, Italy, Sept. 7 to 12, in connection with the international electrical congress. The last plenary convention was held in 1908 at London, when Prof. Elihu Thomson was elected president, following Lord Kelvin. A reunion, or unofficial conference, of the commission was, however, held last year at Brussels. The Brussels conference, as was duly reported in these columns, voted to recommend several international projects to the respective national committees and representative institutions. These projects related to international electrical nomenclature, international electrotechnical symbols, international direction of rotation in vector diagrams and international rating of electric machines. In regard to nomenclature, progress was reported at Brussels on a certain international list of terms recommended by the German committee and dealing principally with dynamo-electric machinery. An international committee was also appointed to work on the subject and report at Turin. The project is that, eventually, an official list of equivalent terms will be established commencing with French and English, the two official languages of the commission, and extending later to the languages of all the countries represented; so that, finally, there can be no misunderstanding as to the international meaning of the principal terms in electrical engineering. It was found, for example, that progress could not be made on the international rating of machines, because certain terms had slightly different meanings in different countries.

The project of international electrotechnical symbols made considerable progress at the Brussels conference. A tentative list of eight symbols was adopted and recommended. No progress could, however, be reported upon the symbols for current strength and resistance in Ohm's law, because of the differences of usage in different countries, *I* being used for current in nearly all countries except Great Britain, and *R* being used for resistance in nearly all countries except Germany. Within the last few months, however, an understanding has been reached mutually between these countries to the effect that each will give up its past usage in this matter for the sake of international comity. Consequently, the hope is expressed that at Turin international agreement will be reached, not only on the preliminary eight symbols recommended at Brussels, but also on the symbols *I*, *R* and *C*, for current, resistance and capacity respectively, thus including the international symbolic expression of Ohm's law. The project of international agreement on vector diagrams was brought to the attention of the Brussels conference by the American committee, which reported the vote, to that effect, of the

Jefferson convention of the American Institute of Electrical Engineers. It was agreed to recommend the matter for consideration at the next convention. It is to be hoped, therefore, that some international decision may be reached at Turin on this important electrotechnical question. At present alternating-current electrical literature is divided into two groups, which make advancing phase in its vector diagrams rotate in opposite directions; so that in reading a book it is necessary to find out, from the context, what is the order and meaning of the quantities displayed on the diagrams. Since this is a matter of convention, and not of fundamental mathematical necessity, the direction of phase advance should be standardized internationally.

In regard to the rating of electrical machinery, but little could be accomplished at Brussels, owing to the backward state of the necessary nomenclature or definition of international terms. It is understood, however, that the matter will come up for discussion and perhaps the convention may be in a position to make an advance. The project is that ultimately the rating of a machine, in kilowatts, will be the same in all countries. At the present time a machine receiving its rating in one country would be likely to have its rating changed if transferred to and standardized in another country. Since the rating of a machine should only involve its physical properties under defined conditions, it is very desirable that the specification of those properties and conditions should be the same, by international convention, all over the world. A parallel case might be presented if freight or passenger steamships had different power—or tonnage—rating in the ports of different countries. Such an unnecessary complication of purely conventional attributes would at once call for international settlement. Other matters are likely to come up for discussion at Turin, such as the excellent suggestion of the French committee to call the quadrature volt-amperes of the alternating-current circuit by the name "reactive power." But if this and the list of subjects already outlined receive definite action, the time of the commission will have been well filled. Twenty countries are now represented on the commission and some sixty or seventy delegates are expected at the Turin convention.

A RESISTANCE METHOD FOR OBTAINING THE INSTANTANEOUS PERFORMANCE OF INCANDESCENT LAMPS.

An interesting series of alternating-current Wheatstone-bridge measurements of incandescent filament resistances at different phases of the current wave appears in the article by Messrs. Edwards and Conner on page 441. The bridge with the lamp under test in one of its arms is supplied with alternating currents from electric-light mains, and a rotating-contact device closes the galvanometer circuit once in each current cycle. The measurements show that the tungsten filaments varied from ± 0.9 to ± 1.78 per cent above and below the mean working resistance, depending upon the size of the filament. The thinner the filament or the lower the wattage of the lamp the greater the cyclic change in resistance owing to the increased cyclic elevation of temperature. The tantalum lamp was less affected in resistance than the tungsten lamps, while the carbon lamps were still less affected, and affected in the reverse direction. The method should prove very useful in bringing to light the electric behavior of metallic filaments carrying alternating currents. It will be seen that the cyclic change in candle-power amounted to as much as ± 18 per cent in one instance. The simplicity and convenience of the method described are very striking.

DISTRIBUTION ABOVE 2200 VOLTS.

For ordinary city distribution for lighting purposes 2200 volts has long been the standard, but in recent years there has been a decided tendency to distribute energy for use in large quantities at voltages from 5000 to 13,000. Several causes have been at work to this end. For example, if a company transmits energy from a hydroelectric plant to a distant market at voltages anywhere from 30,000 to 100,000 the substation equipment for reducing this voltage becomes quite an elaborate affair on account of the high primary voltage to be handled. Moreover, in many cases it is not feasible to transmit to large consumers within a radius of 10 miles of the main substation at the ordinary standard of 2200 volts, as the capital required would be excessive. On the other hand, it would not be feasible to deliver a transmission-line voltage anywhere from 30,000 volts to 100,000 volts at the consumer's premises, because the substation equipment needed would be too costly. For this reason the majority of hydroelectric energy transmission companies have adopted voltages from 5000 to 13,000 for distribution over the districts covered from their main substations. In the case of large consumers like electric distributing companies a second reduction of voltages is therefore made before the 2200-volt distribution is begun. In other cases, if the consumer is a large manufacturer, for example, the step down to the final voltage is made in one transformation at the consumer's premises.

The present tendency above noted is in the simplification of the apparatus used in transforming from voltages of 6000 to 13,000 to that of the consumer's service. A paper read by Mr. Howard Pett at the last Michigan Electrical Association convention described the system of a large hydroelectric company in Michigan in which small sizes of pole transformers are used for stepping down from 6600-volt distribution. There is a strong incentive to the employment of simple pole-type transformers for supplying energy from lines of this voltage, because of the consequent increase of the area of economical distribution and the possibility of taking on consumers otherwise too far apart to serve. This is especially true where lines pass through farming districts, where many a profitable motor customer can be obtained if the step-down transformation is not too costly. The difficulty is not so much with the transformers themselves as with the protective apparatus used therewith, such as fuses and lightning arresters. Developments are under way looking to the simplification of this protection problem, even for voltages over 30,000. The necessity for lightning protection at each transformer has perhaps been overestimated, but the fuse problem certainly has not. It is by no means easy to get a satisfactory pole-type fuse

for voltages over 2200. The weather conditions are trying and fuses must be of a type replaceable safely by ordinary linemen, or by the farmers themselves on rural lines.

THE PRIMARY STANDARD OF LIGHT.

A primary standard of luminous intensity or of luminous flux satisfactory both from the scientific and the practical side has yet to be produced. The standards at present in use, such as the hefner and the international candle, are fixed with great care and are closely reproducible. But they stand practically alone among present-day standards in that they are unconnected with the fundamental units of space, mass and time. Until thus co-ordinated they can be considered little more than convenient reference marks to be used in practice, pending the determination of their real values. The sensation of light is caused by the impinging of radiant energy upon the retina, and consequently one must look to the measurement of radiation for the scientific specification of the standard of light. However, mere intensity of radiation is not a measure of luminous intensity, for not only is a large part of the radiation from most light sources invisible, but even the visible part varies greatly in capacity to produce the sensation of brightness. Furthermore, the mode of action of the eye is such that the luminous equivalent of radiation at a given spectral wave-length varies with the absolute illumination—the Purkinje phenomenon and its allies. At present, too, a considerable obstacle to establishing a connection between radiation and light is the absence of general agreement as to methods, instruments and conditions under which heterochromatic comparisons shall be made. It is because of these complications that the "mechanical equivalent of light," as it has been called—a quantity expressing the relationship between visible radiation and light flux, and varying with the source—is not a satisfactory specification for a standard source in terms of energy. A specification in terms of radiant energy taking into account all essential relationships between light and energy, is necessary.

In a paper presented before the American Institute of Electrical Engineers in July, 1908, Dr. C. P. Steinmetz proposed a primary standard of light based upon radiation and using the mercury-vapor lamp as the source of three selected monochromatic radiations in specified proportions. More recently two other suggestions have been made along somewhat similar lines. Dr. Herbert E. Ives, in a paper in the *Transactions* of the Illuminating Engineering Society on "Energy Standards of Luminous Intensity," suggests as the unit of flux the flux connected with "a definite quantity (per cm²-sec.) of the most efficient possible radiation," to be attained practically by the use of the monochromatic green mercury radiation, which is of sufficient intensity to measure both as radiation and as light. Dr. R. A. Houstoun, in a paper in the *Proceedings* of the Royal Society on "The Absolute Measurement of Light," suggests a specification of considerably greater length, as follows: "The unit of light intensity is that source the total intensity of radiation from which at an optical distance of 1 m, after passing through an ideal filter, would be x ergs/cm²-sec.; the ideal filter to be one possessing the light-absorbing properties of a 3-cm thick aqueous solution of $CuSO_4 5H_2O$ of strength 0.200 gramme-molecule per liter and a 1-cm thick aqueous solution of $K_2Cr_2O_7$ of strength 0.0025 gramme-molecule per liter, but neither to reflect nor to absorb any light in any other way." The "ideal solution" here mentioned involves essentially the idea published by Fery, and carried out in his direct-reading photometer—a solution whose transmission shall be as the luminosity curve of the normal eye. Dr. Houstoun's contribution, in fact, consists in adding the idea of measuring the radiation through such a screen in absolute units. Moreover, it would appear that Dr. Houstoun's suggestion is practically identical with that of Dr. Ives. For if by an "ideal screen" one understands not a particular mixture of chemicals, but a truly ideal screen whose transmission represents exactly the luminosity curve of the eye, then x ergs/cm²-sec. becomes the "quantity (per cm²-sec.) of the most efficient possible radiation" specified by Dr. Ives. In short, the function of an "ideal screen" is merely to reduce any radiation to the intensity which, if the reduced radiation were the most efficient possible, would produce the same luminous intensity as is actually given by the unscreened source. Dr. Houstoun's suggestion can be looked upon as a possible method for obtaining the unit of Dr. Ives from *any* light source; or Dr. Ives' practical suggestion of the use of the green mercury radiation may be considered as a possible method for carrying out Dr. Houstoun's idea without the necessity of interposing an "ideal screen" in the energy measurement.

The important point to notice is, that by either suggestion the brightness of any source of light is connected with a quantity of radiation. This quantity of radiation is, in the suggestion of Dr. Ives, the least quantity which can produce a sensation of brightness equal to that in question. In the suggestion of Dr. Houstoun the quantity of radiation measured becomes this least quantity, provided a truly ideal screen be specified, as suggested above. In fact, the embodiment of a merely experimental chemical mixture (necessarily only an approximation to the ideal screen) into Dr. Houstoun's proposed standard, while the fundamental significance of the quantity x ergs/cm²-sec. as the least mechanical equivalent of light is apparently ignored, constitute the chief objection to Dr. Houstoun's suggestion. Should these suggestions be followed up and prove practicable, photometric quantities and measurements would not only take their place in the c.g.s. system, but would experience a very desirable simplification. For instance, should the new unit of flux, or "lumen," be made the flux given by 1 watt per cm² of the most efficient radiation, then the "lumens" per watt of any illuminant is at once its efficiency on an absolute scale. That is, in place of having two scales of efficiency for a carbon lamp, namely, "four lumens per watt" and 0.43 per cent "reduced luminous efficiency," there would be one figure, N lumens per watt, N also representing the efficiency in terms of the maximum possible efficiency. Before, however, this simplification can be achieved there must be general agreement as to methods and conditions of illumination which are to hold in heterochromatic photometry; for the question of the relative brightness or efficiencies of different colored radiations is directly involved in any theoretically satisfactory proposal to measure light as radiation.

Present Status of Legislation Regarding Niagara Falls.

By the express terms of the act and the terms of its extensions the Burton law expired June 29, so that there is at present no law in effect restricting the importation of electrical energy from Canada into the United States. The restrictions which now govern the diversion of water from the Niagara River for power purposes are those imposed by the provision of the "Water Ways Treaty" between Great Britain and the United States, which was signed Jan. 11, 1909, and proclaimed by the President May 13, 1910. This treaty prohibits diversion for power purposes in excess of an aggregate daily diversion at the rate of 20,000 cu. ft. per second in the United States and at the rate of 36,000 cu. ft. per second in Canada. No measure, however, has been adopted by Congress providing for the administration of the details in respect of such restrictions, such as the granting of permits for the allowable diversion and for the prevention of violation of the restrictions. The President, however, has doubtless general authority to take suitable action preventing such violations.

A bill was introduced in both branches of Congress at the present extra session providing for putting the treaty into effect, arranging the details for carrying out its provisions, prohibiting all diversion within the United States, except in the aggregate amount allowed by the treaty and authorized by the Secretary of War to grant permits for allowable diversion, providing in certain instances for the concurrence of the Treaty Commissioners and the authorities of the State of New York, within the territorial limits of which State only such diversion must be made. Neither the Senate committee on foreign relations nor the House committee on foreign affairs, to whom these bills were referred, took any action on them.

A further bill was introduced in the Senate by Senator Burton extending all of the provisions of the Burton act during the life of the treaty. This bill was passed by the Senate after the foreign relations committee amended it so that the provisions of the Burton law were extended for two years only. The Senate bill was considered by the House committee on foreign affairs and laid over until the regular session. As the bill in the form adopted by the Senate provides for the time extension of provisions which are no longer in effect, it doubtless will require amendment before being acted upon by the House.

The commissioners who negotiated the treaty had before them all of the reports of the War Department and all other attainable data in respect of diversion and of the effect thereof on the Niagara River and Niagara Falls, and it would seem that the proper logical legislation would be an act preventing all diversion in excess of the amount permitted by the treaty and providing for a proper and effective administration of the provisions of the treaty.

Insull Becomes Chairman of Chicago Metropolitan Elevated.

Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, was on Aug. 14 elected chairman of the board of directors and of the executive and finance committees of the Chicago Metropolitan West Side Elevated Railway Company. Mr. Britton I. Budd, president of the Metropolitan company, was recently made president of the new Chicago Elevated Railways Company, of which Mr. Insull is chairman of the executive committee. Other newly elected directors of the Metropolitan company chosen at the same meeting were Messrs. John F. Gilchrist, W. H. Fox, J. H. Gulick, Ira M. Cobe, Henry A. Blair and Gilbert E. Porter. Messrs. Frederick A. Delano, former chairman of the board, H. G. Hetzler and B. I. Budd were re-elected as directors.

Indiana Electric Light Convention.

The third annual convention of the Indiana Electric Light Association will be held at the Oliver Hotel, South Bend, Ind., Aug. 23 and 24. The Wednesday morning session will be given up to miscellaneous business and the annual address by the president, Mr. F. A. Bryan, of South Bend. Immediately after noon the members and visitors will be taken on special cars to Berrien Springs, Mich., to inspect the hydraulic plants of the Indiana & Michigan Electric Company, where a buffet luncheon will be served under the dam. The trip will then be resumed to St. Joseph, Mich., where the meeting will be called to order at the Edgewater Club and the following papers will be read and discussed: *Heating in Connection with Central-Station Work,* by Mr. John Hornung, of W. H. Scott & Company, Chicago; *Economies of Operation Secured by Consolidation of Small Properties,* by Mr. L. B. Andrus, general superintendent Indiana & Michigan Electric Company, South Bend, Ind.; *Power,* by Mr. R. A. MacGregor, manager Light, Heat & Power Company, Connersville, Ind. At 6:30 dinner will be served, following which there will be social entertainment.

On Thursday morning the meeting will again be called to order at the Oliver Hotel, South Bend, and the following papers read: *Rural Service,* by Mr. C. E. Layton, Lebanon, Ind.; *The Steam Turbine for Future Work,* by Mr. E. D. Dreyfus, commercial engineer Westinghouse Machine Company; *Affiliation with the National Association,* by Mr. John F. Gilchrist, president National Electric Light Association; *Curtis Steam Turbine Installations,* by Mr. G. R. Parker, General Electric Company.

During the meeting the by-laws will be amended in order to permit the holding of the annual meetings in October instead of August as at present. Mr. J. V. Zartman, of Indianapolis, is secretary.

A Serious Shut-Down in Spokane.

A short-circuit and fire in two manholes containing heavy cables shut down a large part of the city lines of the Washington Water Power Company, Spokane, Wash., for nearly three hours on Friday morning, Aug. 4. The cables affected were feeders from the Monroe Street station on the Spokane River to the three-wire system which supplies practically all of the light and power service in the business district of the city; as the manholes also contained street railway feeders the street-car system was also crippled. The ducts carrying the cables run up the hill above the power house and thence beneath Lincoln Street.

Fire was discovered in two manholes in Lincoln Street about 7:30 a. m. The efforts of the company and the fire department to extinguish it with chemicals and water soon showed that nothing could be done without cutting off the current and interrupting the service.

A large storage battery had recently been tied into the three-wire system and when the generators were cut off it continued to supply a heavy current, as circuit-breakers had not been provided between the battery and the line; considerable difficulty was experienced in promptly cutting off this source, thus aggravating conditions in the manholes.

The resulting shut-down was one of the most serious in the experience of the Washington Water Power Company, but the emergency was met in an unusually efficient manner. As soon as the current was cut off the water was pumped from the manholes. It was then found that heavy arcs had totally destroyed the insulation on every cable and fused the burned ends together. As rapidly as possible the cables were cut apart and the fused mass removed, eliminating the short-circuits. Work in the man-

holes was extremely difficult, due to the heat and fumes, but by 10:30 a. m. the cables had been cleared and service was restored on the three-wire system in the central business district, using auxiliary tie feeders in other streets.

In the meantime current was supplied to the trolley lines down town over one overhead feeder, the circuit-breakers, being bridged temporarily so that the current was distributed directly to the trolley wires. Linemen patrolled the tracks and strung emergency wires wherever the current was found too heavy for the trolley wires.

A temporary overhead cable was thrown across Lincoln Street and connected to the light and power circuits in the southeast portion of the city, which service was carried for a short time after the accident on only one feeder. New temporary cables were also laid in the street in rough wooden troughs. The situation was thoroughly in hand by 11 a. m., and by 3 p. m. a new system of street-railway feeders had been strung overhead.

The most plausible theory of the cause of the accident is that the insulation in one of the 13,000-volt cables broke down, precipitating the short-circuit in the manholes.

Production and Price of Copper in 1910, and the Present Outlook.

By JOHN B. C. KERSHAW.

The writer has for some years been studying the production and price curves of the copper industry and has been accustomed to publish during each year a summary of the results of this study of the past year's statistical information and also a forecast of the future course of output and prices during the remainder of the current year. The large amount of copper used in the electrical engineering industries and the marked variations in price which have occurred in the history of copper during recent years should render the subject of special interest and value to the readers of the *Electrical World*. The figures used in the course of the article are those collected by the correspondents of the *Engineering and Mining Journal*, of New York, for the American and Mexican mines, and by Messrs. H. R. Merton & Company, of London, for the remaining copper-mining countries. The annual statistical circular published by the latter firm appeared on March 29, 1911.

PRODUCTION IN 1910.

The aggregate output of raw copper by all countries of the world in 1910 amounted to 852,950 tons, an increase of 13,525 tons over that of 1909. This falling off, as compared with the gain of nearly 85,000 tons in 1909, was due to the attempt to curtail production and to reduce stocks on the part of those in control of some of the larger and more important mining companies. The effect of this curtailment of production upon stock prices will be dealt with below.

TABLE I.—WORLD'S AGGREGATE PRODUCTION OF RAW COPPER.

Year.	Aggregate Production in Long Tons of 2240 Lb.	Increase in Tons.	Percentage Increase.
1901	516,626	37,114	7.7
1902	541,295	24,669	4.7
1903	574,775	33,480	6.1
1904	644,000	69,225	12.0
1905	682,125	38,125	5.9
1906	714,100	31,975	4.6
1907	713,965	(135)*	....
1908	754,180	40,225	5.7
1909	839,425	85,245	11.2
1910	852,950	13,525	1.6

* Decrease.

Tables I and II give the more important figures for the output of copper during the past ten years, and Fig. 1 gives in graphic form the production curves for the six more important mining companies.

The percentage increase in 1910 was, therefore, the smallest of the past ten years with the exception of 1907, when an actual decrease in production of 135 tons was recorded. The aggregate increase in annual output comparing 1900 with 1910, however, is 373,436 tons, equal to nearly 80 per cent, and in 1911 or 1912 one may expect to see the production figures of 1900 doubled and the copper output of all countries of the world approach 1,000,000 tons per annum.

As regards the production figures for the leading countries, Table II gives the totals for the last two years for all countries with an output of 5000 tons or over.

TABLE II.—COPPER PRODUCTION IN 1909 AND 1910 OF THE LEADING PRODUCING COUNTRIES.

Country.	Production in Long Tons.		Increase in Long Tons.	Decrease in Long Tons.
	1909.	1910.		
Africa	14,945	15,205	60	.....
Australasia	34,400	40,315	5,915	.....
Canada	24,105	25,715	1,610	.....
Chili	35,785	35,235	.....	550
Germany	22,455	24,710	2,255	.....
Japan	47,000	46,000	.....	1,000
Mexico	56,325	58,825	2,500	.....
Norway	9,280	10,425	1,145	.....
Peru	16,000	18,305	2,305	.....
Russia	17,750	22,310	4,560	.....
Spain and Portugal	52,185	50,255	.....	1,930
United States	490,280	484,890	.....	5,390
Totals	820,510	832,190	20,360	8,870

The above twelve countries in 1910 yielded over 97 per cent of the copper supplies of the world.

On examining the figures of Table II more closely it is found that four of the producing countries have decreased in output, namely, Chili, Japan, Spain and Portugal and the United States, while eight countries have to record increases varying from 60 tons up to nearly 6000 tons, Russia and Australasia heading the list of countries whose production is on the up-grade, with increases of 4560 tons and 5915 tons respectively.

In the light of the attempts made during 1910 to curtail production the detailed figures for the mines and mining countries under the control of the United States of America financiers are of special interest and are given in Table III.

TABLE III.—COPPER PRODUCTION IN 1909 AND 1910 OF AMERICAN-CONTROLLED MINES.

Country.	Production in Long Tons.		Increase	Decrease
	1909	1910		
United States:				
Calumet and Hecla	40,000	35,000	.....	5,000
Other lake mines	61,450	62,770	1,720	.....
Montana	140,105	128,770	.....	11,330
Arizona	130,375	132,625	2,250	.....
Other states	118,350	125,725	7,375	.....
Mexico:				
Boleo	12,230	12,795	565	.....
Other Mexican	44,095	46,030	1,935	.....
Chili	35,785	35,235	.....	550
Peru	16,000	18,305	2,305	.....
Japan	47,000	46,000	.....	1,000

The decreased production of the United States is thus seen to be confined to the Calumet and Hecla and Montana mines, whereas the other lake mines and the mines of Arizona and other states record small increases. Of the other countries included in Table III Chili and Japan alone show a decreased production, which is more than balanced by the increased output of the mines in Mexico and Peru.

With these figures before one, it is evident that the curtailment of production which was expected in 1910 as the result of a merger policy on the part of the financiers in-

terested in the United States of America copper mines has not been very rigorously enforced outside the Montana area, and that unless there is a distinct improvement in the demand for copper during 1911 a much stricter check to production in the mining districts of the American continent will be necessary in order to bring about the rise in values so ardently desired by the speculators in copper.

Whether the conflicting financial interests involved in the control of the American copper-mining industry will be able to arrange some common and united action in this matter of curtailment is the question of the moment, and the writer will make some attempt to answer it after discussing the variations in price that have occurred during the past fifteen years.

PRICE AND STOCK VARIATIONS IN 1911.

The price variations of copper during 1910 have been almost entirely in a downward direction, and a fall of $29.37 per ton occurred between Dec. 31, 1909, and Dec. 31, 1910. The settlement prices of standard copper at the close of each month are given by Messrs. H. R. Merton & Company in their valuable monthly circular for March, 1911, as follows:

TABLE IV.—PRICE VARIATIONS OF COPPER DURING 1910.

Dec. 31, 1909	$308.75	June 30, 1910	$272.50
Jan. 30, 1910	304.37	July 30, 1910	277.50
Feb. 28, 1910	298.12	Aug. 31, 1910	279.37
March 31, 1910	289.37	Sept 30, 1910	275.62
April 30, 1910	279.37	Oct. 31, 1910	285.00
May 31, 1910	284.37	Nov. 30, 1910	286.25
Dec. 31, 1910	279.37		

Since the commencement of the present year the depreciation in the value of standard copper has continued, and on March 31, 1911, the settlement price was $272.50 per ton. The average price of standard copper on the first of each month for the past three years has been $300.12 in 1908, $294.31 in 1909 and $285.79 in 1910, so that the fall in values is rather over-accentuated by the comparison of the value on March 31, 1911, with that of Dec. 31, 1909, when the price was at the highest point touched for twelve months.

Fig. 2 shows the annual average price variations of copper from 1896 to 1910 plotted as a curve, and from the study of this curve, supplemented by the figures given by Messrs. H. R. Merton & Company for the stocks of copper held in England, France and America (or afloat thereto from Chili and Australia), some idea of the course of prices during the next twelve months may be gained. The downward trend of the price curve has now lasted over three years and one might reasonably have expected it to follow the example of the recovery of the year 1903, and to commence once again to ascend during 1910 if no outside influences had been at work to check or retard this recovery. One of these influences has been the large stocks of copper that had gradually accumulated in dealers' and manufacturers' warehouses during the year 1909. H. R. Merton's & Co. figures for the combined visible supplies of copper in Europe (excluding Holland and Germany) and in America, as reported by the American Producers' Association, during fifteen months are as below.

The cause of the failure of copper to rise above the present low level of values is thus seen to be this heavy incubus of stocks, which on Feb. 28, 1911, were only 9000 tons less than on Feb. 28, 1910, and represent nearly 2.5 months' supplies on the present basis of demand. The stocks held in Europe have, it is true, fallen by 27,000 tons (from 109,022 tons to 82,387 tons) during the fourteen months covered by the above table, but the American stocks have increased by over 6000 tons (from 63,288 tons to 69,924 tons) in the same period. It is practically certain that no marked recovery in price of the metal will occur until the stocks have been worked down to the more normal level of Dec. 31, 1908, when Europe and America each held about 55,000 tons of copper as visible supplies.

TABLE V.—STOCK VARIATIONS IN EUROPE AND AMERICA DURING 1910.

Dec. 31, 1909	$172,310	Aug. 31, 1910	172,899
Jan. 30, 1910	154,765	Sept. 30, 1910	160,386
Feb. 28, 1910	161,306	Oct. 31, 1910	150,592
March 31, 1910	166,711	Nov. 30, 1910	144,460
April 30, 1910	173,593	Dec. 31, 1910	138,275
May 31, 1910	178,434	Jan. 31, 1911	146,783
June 30, 1910	179,129	Feb. 28, 1911	152,311
July 30, 1910	$175,418		

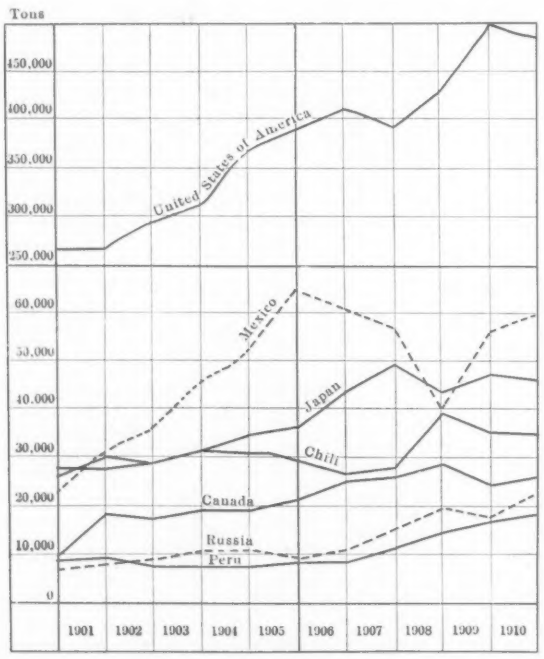


Fig. 1—Production Statistics of Copper 1901—1910.

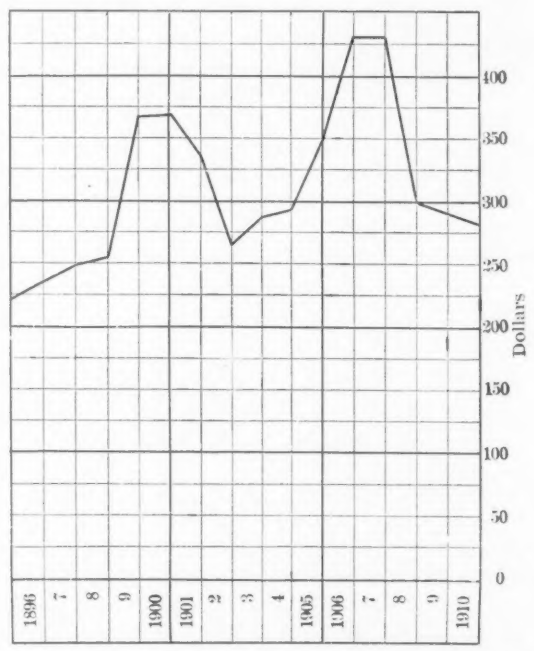


Fig. 2—Price Variations of Copper from 1896 to 1910.

Trade in Europe is booming and the demand for copper in the electrical-engineering and shipbuilding industries must be at its maximum. In America the recovery from the financial and industrial depression of 1907 and 1908 is still delayed, and this to some extent explains the slack demand for copper and the failure to reduce stocks in that country.

The revival of activity of American manufacturing in-

dustries is, however, now overdue and is likely to take place either this year or next if no unforeseen events occur to hinder it. This revival, combined with a continuance (in perhaps a more vigorous form) of the present policy of restricted production on the part of the American copper magnates, should lead to a depletion of stocks on both sides of the Atlantic and to the recovery in price which has long been expected. It is improbable that the high prices of the year 1907 will be touched by the metal during 1911, but a recovery to $300 or to perhaps $325 per ton, in the writer's view, is almost certain to occur before the close of the year unless a sudden check to the manufacturing prosperity of Europe should cause a marked slackening in the demand for copper on that side of the Atlantic.

Electrolysis Situation in Chicago.

Possibility of damage to buried metallic structures by corrosion due to the electrolytic action of stray electrical energy, usually ascribed to the ground return of electric railways, is a subject that is discussed at intervals in nearly all American cities. In Chicago the situation is not at all acute; nevertheless, there has been a quiet investigation of the situation for some time by the city authorities and various public-utilty companies interested. The idea now is less to punish the companies for any mistakes or carelessness in the past than to plan a concerted movement by which the subject may be studied jointly and measures for relief adopted.

At a recent meeting held in the office of Mr. L. E. McGann, the commissioner of public works for Chicago, the question of the effect of electrolysis on underground utilities was brought up, and Mr. Bion J. Arnold, chairman of the board of supervising engineers, Chicago Traction, was requested by Mr. McGann to make a statement showing what has been done in this matter by the board of supervising engineers. Mr. Arnold subsequently wrote a letter to Mr. McGann containing some interesting information on this subject.

PRACTICE OF THE BOARD OF SUPERVISING ENGINEERS.

In the rehabilitation of the Chicago surface street railways it was decided at the outset that the tracks should be reconstructed in such a maner as to eliminate, as far as possible, the escape of electricity from the rails. This was done by supplementing the rail connections themselves on all new work with a return copper conductor or conductors laid between the rails and attached to the latter at frequent intervals. In order to meet the probable future growth of the street-railway system and provide against a path for the return current in case of broken joints, it was decided to lay no track unless supplemented by a return conductor, and that for double track a conductor not less than 500,000 circ. mil in section should be used. As the flow of electricity is greater near substations and power houses, this supplemental conductor has been increased in size at many locations so that in not a few instances there have been from two to twelve 1,000,000-circ. mil cables laid to supplement the rail return.

The present Chicago city ordinances relating to electrolysis require that the joints of the rails shall have a conductivity equal to the conductivity of the rail itself. This provision has been carried out by the board of supervising engineers, which has provided welded joints on all new track except at a few points, such as on special work, where it has been impracticable to weld the joints. In these cases copper cables have been provided to connect the main rails. The rails have also been connected together and to the supplemental return cables with copper cross-bonds placed at frequent intervals.

After adopting this standard of track construction it became evident that the necessary information upon which to base conclusions regarding what should be done with other structures, to prevent the destructive effect of electrolysis on underground utilities, might be gathered by co-operative action on the part of the public-utility companies and the board of supervising engineers. The result was that a sub-committee on electrolysis, consisting of representatives of the board and each of the utility companies interested, was appointed.

The committee has endeavored to recommend a practical method for the prevention of electrolytic action between the various underground metallic surfaces in the city of Chicago. The committee has investigated the conductivity of cement, concrete and earth materials, measured the resistance of various cables, conduits and pipes, made extensive electrolytic surveys and done much other work, including the investigation of an extensive drainage system for protecting pipes in power stations. The committee's final recommendations are about to be formulated, and in the meantime certain physical connections have been made between the tracks of the surface railway companies and some of the elevated railway companies with marked effect in the reduction of the flow of electricity and consequent reduction in electrolytic effect.

In concluding his interesting communication Mr. Arnold says that it is his intention, as soon as the committee mentioned makes its formal report, to take up the subject with the city officials with a view of securing their co-operation and carrying out a definite policy for the bettering of conditions.

REPORT OF BUREAU OF PUBLIC EFFICIENCY.

The Chicago Bureau of Public Efficiency has made a report, dated July, 1911, on "Electrolysis of Water Pipes in the City of Chicago." Mr. Herbert R. Sands, who is the director of this bureau, which is a private body of public-spirited citizens, says it is believed that at least two-thirds of the water pumped into the city mains is wasted. A large part of this waste is attributed to leaky water pipes. Possibly some of these leaks may be due to corrosion caused by electrolysis. The Chicago Bureau of Public Efficiency has therefore made a partial study of present electrolytic conditions as affecting the Chicago water mains. The survey was conducted by Mr. A. J. Hammond, chief engineer of the bureau, and Mr. H. J. McDargh, assistant engineer. The report recommends that a complete electrolysis survey of the entire city should be made by the city authorities. Such a survey should include (1) location of all positive and negative territories; (2) examination of all water pipes found to be carrying current, ascertaining whence the current comes, its point of departure and where it goes; (3) analysis of soil in "positive" districts; (4) sufficient tests of railway track rails to determine their efficiency as conductors. It is asserted that the board of supervising engineers has collected numerous data on the subject, but that nevertheless much remains to be done.

The report goes on to consider the relation of electric railways to electrolysis and briefly refers to legal proceedings by various cities and water companies, also dwelling on the importance of the subject in Chicago and the necessity for immediate action. Some "horrible examples" of electrolysis are cited, possibly the most interesting being the following:

"One of the large department stores in Chicago experienced the injurious effect of electrolysis through the failure of one of its 6-in. water mains in the basement. This bureau received an invitation to investigate and found that current from the electric railways was entering the building by the water and gas service pipes and following the piping and structural steel of the building until it found its way to the rails of the Illinois Tunnel Company's track. This investigation disclosed a 6-in. pipe in the building carrying 59 amp of current."

The People's Gas Light & Coke Company, according to this report, has greatly reduced the damage to its system by bonding with copper wires the gas mains in "positive" territories to the track rails. Further, each joint in the gas mains was bonded with two No. 0000 copper wires. These joints are 12 ft. apart. In addition, at a number of places copper cables varying from 500,000 to 1,000,000 circ. mil were tapped into the gas mains and carried to negative busbars at power stations.

The report goes on to show how its survey was made and in an appendix is a long list of readings made at various locations with voltmeters and ammeters. Discussing remedies, the report says that the double trolley system will be impracticable. Various methods heretofore suggested are mentioned and, while the Chicago Bureau of Public Efficiency does not recommend any particular one of these, it believes that means of relief are available.

APPOINTMENT OF EXPERT ON ELECTROLYSIS.

Acting under authority conferred by the City Council of Chicago, which recently appropriated $10,000 for the purpose of making an electrolytic survey of the city, Mayor Harrison on July 25 appointed Mr. Ray Palmer, an electrical engineer, expert for the city to make such a survey and to report the result of his findings. Mr. Palmer, who is an associate of the American Institute of Electrical Engineers, has been employed in similar work in Milwaukee. He will receive $750 a month as compensation and will be required to pay his own assistants.

Ohio Tax Valuations of Public-Service Companies.

The Ohio Tax Commission has fixed a tentative valuation of approximately $18,000,000 on the property of the Union Gas & Electric Company, of Cincinnati. It is possible that some deduction may be made because of the claim that the artificial-gas plant does not pay, but must be maintained in order to retain the franchise granted by the city.

Judge Miller Outcault and Attorney Joseph Heintzman represented the company in a hearing before the commission on Aug. 10. They urged that a valuation of $10,000,000 would be fair. This is an advance of $6,000,000 over the former valuation of $4,000,000, but the members of the commission were not inclined to look upon the matter in that light. The attorneys argued that the company fell about $54,000 short of paying fixed charges last year, and from this argued that the business is not paying. In reply the commissioners said that as the fixed charges include dividends upon stock of underlying companies at a contract rate they would not consider that the company is not earning money as long as it continues to pay these dividends, which they consider unwarranted.

Judge R. M. Ditty, chairman of the commission, told the attorneys that both the commission and the public felt that the holding company alone, and not the State government, is to blame for paying such high returns to others that it is unable to earn money on its own investment. The argument of the company that it should not be valued upon its earning capacity but upon its physical equipment was answered that the property has value only according to its worth as a going concern and that it is unfair to the public to fix its valuation as junk and put it on the tax roll at that.

	Former.	New.
Washington C. H. Gas & Electric Company	$43,630	$120,000
Middletown Lighting Company	22,500	115,000
Middletown Gas & Electric Company	28,000	90,000
Chillicothe Gas Light & Water Company	43,000	180,000
Ravenna Gas & Electric Company	22,855	70,000

The attorneys for the company will have the figures of the report of the company classified and put in systematic shape for reaching the value of various items, and the commission will consider the matter further. These figures will probably go back ten years.

Tentative valuations have been fixed upon the following additional Ohio public-service companies given in the table.

New York Commission News.

The Public Service Commission, Second District, has made its final order in the matter of interborough telephone rates of the New York Telephone Company in Greater New York. An order was made June 1, 1911, reducing various rates which carried reductions of from 10 cents to 5 cents for messages between Manhattan and Brooklyn and between Manhattan and central-station districts, Astoria and Newton on Long Island, and reductions from 15 cents to 10 cents for messages between Manhattan and central-station districts Flushing, Richmond Hill and Jamaica, on Long Island. The New York Telephone Company asked for modifications of the order and the final order now provides for a 5-cent rate instead of 10 cents between Manhattan below 110th Street West and 103d Street East to that section of Long Island included between the Long Island Sound, East River, New York Bay and a line beginning at Sixty-fifth Street and New York Bay following the route of the Bay Ridge Extension & Manhattan Beach Division of the Long Island Railroad easterly from New York Bay to New Lots Avenue; thence easterly on New Lots Avenue to Fountain Avenue; thence northeastly to the intersection of Blake Avenue and Crystal Street extended; thence easterly on Blake Avenue to the boundary line between the Boroughs of Brooklyn and Queens; thence northerly on the boundary line between the Boroughs of Brooklyn and Queens to Forest Park; thence north across Forest Park to a point 100 ft. south of Myrtle Avenue; thence easterly and parallel to Myrtle Avenue to a point 100 ft. east of Dry Harbor Road extended; thence northerly and parallel to Dry Harbor Road through St. John's Cemetery to a point 100 ft. south of North Hempstead Road; thence northeasterly along North Hempstead Road and 100 ft. therefrom as far as Flushing Creek, thence northerly along Flushing Creek to Flushing Bay. It also provides for a 10-cent rate instead of 15-cent between Manhattan, between 110th Street West and 103d Street East, to central-station districts Flushing, Richmond Hill and Jamaica upon Long Island. These rates apply from regular subscribers' stations for a connection of five minutes or less and each additional five minutes or fraction thereof may be charged as another call. To give the company a reasonable time to provide for the additions to its plant and equipment which increased service following reduced rates is sure to demand the company is given until Dec. 1, 1911, to put the reduced rates in effect. The company has agreed to the terms of the order as now made.

The Rockland Light & Power Company has been authorized to issue $100,000 5 per cent bonds to be sold for not less than 93 and the proceeds to be used for extensions and improvements to its plant. The company operates in Nyack and other villages in Rockland County.

Wisconsin Commission News.

By a recent decision of the Railroad Commission in the city of Neenah's case against the Wisconsin Traction, Light, Heat & Power Company a new rate schedule is ordered for all gas sold for whatever purpose used. The

former rate schedule ranged from $1.45 per 1000 cu. ft. for the first 3000 cu. ft. to $1.25 per 1000 cu. ft. for gas sold above 15,000 cu. ft. per month. No discounts were allowed and a minimum charge of 25 cents per meter was made. The schedule ordered effective is as follows: For the first 5000 cu. ft. used per month, $1.15 net; for the next 15,000 cu. ft., $1 net; for the next 30,000 cu. ft., 90 cents net; for all gas used per month in excess of 50,000 cu. ft., 75 cents net. The minimum bill must be graduated from 25 cents to $4 per month according to the size of the meter. The above schedule of rates will return the company 7.5 per cent for interest and profit on a valuation of $320,000. The complaint does not justify an order establishing the proposed rates in all of the territory supplied by the company, but the commission recommends that they be made effective in the cities of Appleton and Menasha as well as in Neenah.

The commission has held hearings in the matter of the refusal of the Merrill Railway & Lighting Company to comply with certain orders. These relate to the question of voltage regulation and the accuracy and manner of testing meters. The officials of the company testified that, after months of fruitless endeavor to obtain a satisfactory voltage regulator from the larger manufacturing companies, a special regulator had been obtained which it was thought would satisfactorily fulfill all conditions. The meter question, however, has not been settled in a manner satisfactory to the commission. The Merrill company uses a meter whose accuracy, as evidenced by tests made by the commission, is not up to the requirements laid down by the commission in its standard of service. To determine if there were any mitigating circumstances or fundamental reasons why this type of meter should not show the same degrees of accuracy as the motor meters, a hearing was held on July 31 at which the manufacturer of the meter discussed its operation, the precautions to be observed in installing and testing and the reasons why, in his opinion, the meters in Merrill showed such a wide variation in accuracy. As a result of the hearings the commission will formulate a special set of regulations to govern the testing and inspection of the type used in Merrill in order that the standards of service for meters, as laid down by the commission, may be complied with.

The commission has authorized the Superior Water, Light & Power Company to issue 5000 shares of common stock, of the par value of $100 each, and 5000 shares of preferred stock, of the par value of $100 each, which stock is to be issued and exchanged for a like amount of common stock now outstanding. The Campbellsport Electric Light & Power Company has been authorized to issue $15,000 par value of stock and $20,000 par value of 5.5 per cent bonds. The stock is to be issued and exchanged for all property and effects now held by Mr. A. Hood, which property and effects were purchased for the company by Mr. Hood and for which no compensation has been given by the company. The proceeds to be derived from the sale of the bonds are to be used for the purpose of paying the outstanding indebtedness incurred by reasons of additions and extensions made to the property, as well as providing working capital. The bonds are to be sold for money only and for not less than 75 per cent of par value.

CURRENT NEWS AND NOTES.

Convention of Municipal Electricians.—The place of holding the next annual convention of the International Association of Municipal Electricians has been changed from St. Paul to Atlantic City, and the date fixed for Sept. 12 to 15. Headquarters will be at Young's Hotel, where there will also be space for exhibits. Mr. Clarence R. George, Houston, Tex., is secretary.

Cuban Hydroelectric Concession.—The Cienfuegos, Palmira & Cruces Electric Railway & Power Company has been authorized to utilize the waters of the Hanabanilla and Negro Rivers and to construct certain railway lines in connection with those already existing in the Province of Santa Clara, Cuba. The company is to be permitted to import free of duty, "within the limits allowed by treaties," the machinery, rails, engines, tools and rolling stock under appropriate restrictions which will be required for the construction and operation of its plant and railway lines. It is stated that all of this material will be purchased in the United States.

* * *

Eighty-Cent Gas Rate Temporarily Established in Chicago.—Judge Gibbons, of the Circuit Court of Cook County, to whom the People's Gas Light & Coke Company presented a petition asking the court to set aside the rates for gas fixed by the City Council, has fixed a rate himself. It may take two years to settle the litigation growing out of the company's suit, and until the final determination of the case the judge has fixed a rate of 80 cents a thousand. The present rate is 85 cents and the City Council rates are 75 cents for the first year, 70 cents for the second and third years and 68 cents for the fourth and fifth years. The order made by the court, which went into effect Aug. 7, provides that consumers paying at the new rate of 80 cents shall receive a refund of so much of said payment as is in excess of the rates prescribed by the city ordinance, provided that these rates are finally adjudged just and reasonable.

* * *

Boston Subway Extension.—The Boston Transit Commission has instructed its engineers to make survey of the routes for the new Boylston Street subway, the Dorchester tunnel and the East Boston tunnel extension. Work will not be begun until the act of the Massachusetts Legislature authorizing their construction has been accepted by the city and by the Boston Elevated Railway Company. The undertakings involve an expenditure of sums estimated at $10,000,000 in the aggregate. By the construction of these tunnels about 4.5 miles of underground transit facilities are to be added in the city of Boston. The Boston Elevated Railway will lease the tunnels and subway in the same way that it leases present subways, and the leases on all the tunnels and subways will run to July 1, 1936, at a general rate of 4.5 per cent.

* * *

Los Angeles Lighting Companies Can Charge for Incandescent Lamps.—An ordinance adopted by the City Council, Los Angeles, Cal., in 1910, lowering the lighting rates and which also required the electric-lighting companies to supply incandescent lamps free to consumers, has been declared unconstitutional by the Supreme Court. In its decision the court holds that the City Council has not the authority to regulate prices that may be charged for lamps or to order lamps to be furnished free, any more than it can determine the cost of wiring a house for electrical service. The city, in its case, contended that the cost of furnishing lamps had been considered in the adoption of the rates.

* * *

Tungsten Outlining of People's Gas Building, Chicago.—The People's Gas & Coke Company, Chicago, has just completed outlining with 100-watt tungsten lamps the cornice and principal architectural lines of its handsome twenty-story office building on Michigan Boulevard. The office and sidewalk lighting is done with high-pressure gas-mantle units, but for all the ornamental illumination the choice was limited to electricity. The corridors of the building and the gas company's own magnificent offices are lighted by gas, but the majority of the office tenants employ electricity exclusively, although every effort has been made to encourage the use of gas.

Institute of Operating Engineers.—The program of the first annual meeting of the Institute of Operating Engineers, to be held in the Engineering Societies Building, New York, Sept. 1 and 2, includes six technical papers dealing with engine and boiler-room operation. An equal number of papers and addresses relate to the status and instruction of the stationary engineer.

* * *

Chicago's First Electric Sign.—The first electric sign of the thousands which now make Chicago's night sky luminous was installed in 1888, according to Mr. H. L. Markham, of Chicago, who mentioned this early display in a recent address. The sign was used by the Iowa delegation to the national Republican convention to urge the nomination of Senator Allison for President.

* * *

Meeting of Incandescent Lamp Manufacturers.—A meeting of incandescent lamp manufacturers will be held during the week of Sept. 3 at Association Island, near Sacketts Harbor, N. Y. During the meeting papers will be presented on the commercial side of electric lighting by Messrs. A. D. Page, Ward Harrison, C. W. Bender, F. M. Tait, C. L. Eshleman, C. O. Baker and P. S. Dodd.

* * *

Commercial Loss from New Invention.—At the semi-annual meeting of the National Electrical Supply Jobbers' convention this week at Saratoga, N. Y., the subject was discussed of the loss entailed on the electrical trade by the activity of inventors. It was stated that great losses are sustained by depreciation in the value of goods which, though up to date when purchased, are supplanted by other inventions.

* * *

Canadian Members of International Waterways Commission.—Under the terms of a treaty ratified last year the following members of the permanent International Waterways Commission have been appointed by the Canadian government: Chairman, Sir George Gibbons, who was chairman of the Canadian section of the old commission; Hon. A. P. Barnhill, a member of the New Brunswick government; Mr. Aimé Geoffrion, K. C., of Montreal. Mr. Thomas Cote, secretary of the old commission, will hold the same office in the new body.

* * *

Tick-Tick Telephones.—The Chicago Telephone Company is installing that type of prepayment telephones where the coin must be inserted before connection can be had with "Central," the subscriber ascertaining that the line is free by listening for a ticking noise in the receiver. There is some objection to the use of these "nickel-first" telephones rather than the "nickel-last" type now quite general in Chicago, but the company insists that it is going to a large expense to make the change because it is in the interest of first-class telephone service to do so.

* * *

Quebec Province to Sell No More Water-Powers.—The government of the Province of Quebec has adopted a new policy regarding water-powers belonging to the crown. In future no water-power will be sold, in perpetuity, as was the case ten years ago when powers at Shawinigan and Grand Mere Falls were sold for $50,000 each. Instead, leases of ninety-nine years will hereafter be granted. The Minister of Crown Lands at Quebec, Hon. Jules Allard, has decided to offer at auction in September next ten water-powers situated in different portions of the province.

* * *

Aeroplanes and Electric Wires.—Mr. J. A. D. McCurdy, one of the aviators contesting in the aero meet held by the Chicago Aero Club on the Chicago lake front, Aug. 12 to 20, suffered the loss of his biplane Aug. 14 when he came down, striking a group of electric-light wires, severing them and setting fire to his machine. Mr. McCurdy's engine gave out 500 ft. in the air and he was forced to coast to the ground. Misjudging his landing, he struck the wires and carried them down in a shower of sparks which set fire to the planes, completely consuming them and the framework of his machine.

* * *

Citizens Destroy Maywood (Ill.) Dam at Midnight.—Declaring that the stagnant water impounded by the condenser-intake dam of the North Shore Electric Company in the Desplaines River near Maywood, Ill., furnished breeding places for mosquitoes and malarial germs, as noted in this column Aug. 5, a body of citizens of the village, which is a suburb of Chicago, led by their town president and marshal, proceeded to destroy the dam shortly after midnight, Aug. 9, cutting an opening 16 ft. wide through the center of the wall. The action was planned secretly and followed a five-day notice to the company to remove its dam. Besides the mosquitoes and danger from typhoid the citizens objected to the stench from thousands of dead and decaying fish which had died in the stagnant pool above the dam.

* * *

Central-Station Baseball Matches.—Rival baseball teams of three electric-lighting companies played a double-header at Oriole Park, Baltimore, on July 29 in the presence of 2000 people. The "White Sox" of the Consolidated Gas, Electric Light & Power Company, Baltimore, first played the crack nine of the Edison Electric Illuminating Company of Brooklyn, losing in twelve innings by a score of 2 to 3. The Baltimore nine then beat that of the United Gas Improvement Company of Philadelphia by a score of 3 to 1. Manager Lafferty brought the Edison squad from Brooklyn and at Philadelphia was joined by Manager Gallagher and the U. G. I. nine. Luncheon was served en route, and at Baltimore the nines were met by the local players and a 'bus, which took them directly to the grounds. A full brass band was on hand during both games, and the Baltimore team had as its mascot a diminutive darky of deep ebony hue who cavorted on a more or less white mule. He failed to have any effect on the Brooklyn players, but cast some sort of a spell over Philadelphia.

* * *

New York Edison Stations Carry Record Summer Load in Electrical Storm.—A severe electrical storm, reported by the United States Weather Bureau as a black squall, with wind at 55 miles an hour, broke over the southern part of New York and nearby sections of New Jersey about 3 o'clock last Tuesday afternoon, and the entire locality affected was practically in darkness for over a quarter of an hour. The approach of the storm was reported by the weather observer of the New York Edison Company and preparations were made for carrying the expected increase in load. Before the storm came the normal summer load, aggregating some 60,000 kw, was being carried by the stations. At 2 o'clock, when the skies darkened, this reached 73,000 kw, and as the sky cleared shortly after this time the load dropped again to normal. At 2:45 intense darkness became widespread and units were placed in operation as rapidly as demand required. The peak on the stations finally reached 105,000 kw in two sudden jumps, which was the highest summer load ever carried, and it was maintained for fifteen minutes. At Waterside No. 1 two 10,000-kw units, six 4000-kw units and one 5000-kw unit were used, and at Waterside No. 2 one 14,000-kw unit, six 10,000-kw units and one 8000-kw unit were in operation to meet the conditions. So efficient were the preparations for meeting the storm that not the least drop occurred in the supply voltage and it was not necessary to fall back upon storage batteries while placing any of the units on the lines.

RAILWAY TERMINAL POWER PLANT.

Production and Distribution of Energy in New Northwestern Passenger Station in Chicago.

MANY unusual and special applications of mechanical and electrical energy in the new passenger terminal of the Chicago & Northwestern Railway Company in Chicago make a description of the completed plant, now that the terminal is in service, well worth while. However, a rather elaborate account of the "Electrical Features of the New Northwestern Railroad Terminal in Chicago" appeared in the *Electrical World* of July 8, 1909, in the early stages of the work on the great terminal, which has now cost over $25,000,000. That article was quite complete at that time, and it will perhaps not be necessary to repeat a general description of the terminal buildings and tracks. A general street-level plan of the whole terminal is given in Fig. 2.

As shown clearly by this drawing, the terminal has its greatest dimension along Clinton Street, by which it is bounded on the west. Lake Street, Randolph Street and Washington Street are east-and-west streets crossing the terminal underneath the railroad tracks, which are elevated. The terminal may, therefore, be considered as divided into four portions, and the power plant occupies the triangular section occupying the extreme northern portion, as shown in Fig. 2.

The station building proper, referred to here for convenience as the main building, is at the other end of the terminal, facing on Madison Street. From the corner of Milwaukee Avenue and Clinton Street, where the power-house stack is located on the northern corner of the terminal, to the front of the building on Madison Street is a distance of 1450 ft. The main building is a four-story structure of the early Italian Renaissance style of architecture, having granite walls and with a lofty Doric portico at the Madison Street entrance, supported on a colonnade of six granite columns, each 7 ft. in diameter at the base and 61 ft. high. The main waiting-room, which is the principal architectural feature of the station, is treated as a great Roman atrium with a barrel vault roof. The lighting features of the main building, the heating and ventilation of the terminal and many miscellaneous utilities will be treated in a succeeding article.

POWER-HOUSE DESIGN.

Considerable ingenuity has been displayed in the design of the power station by the consulting engineers, owing to the limitations in space and the unusual shape of the ground available. In the power house on this triangular lot all of the energy used for heating, lighting, ventilating and operating the various utilities of the terminal is generated. Fig. 3 is an exterior view taken at the corner of Milwaukee Avenue and Clinton Street.

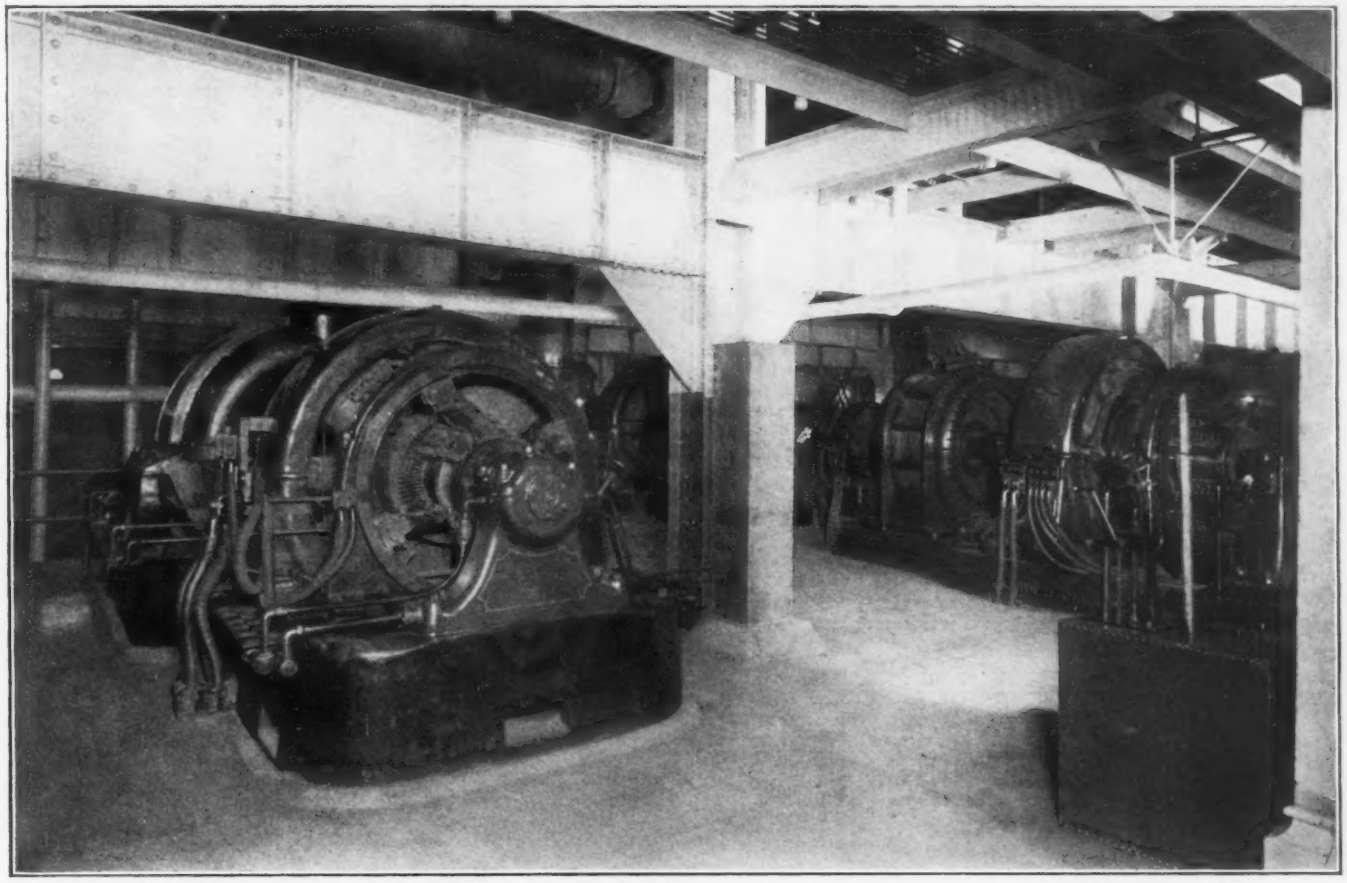
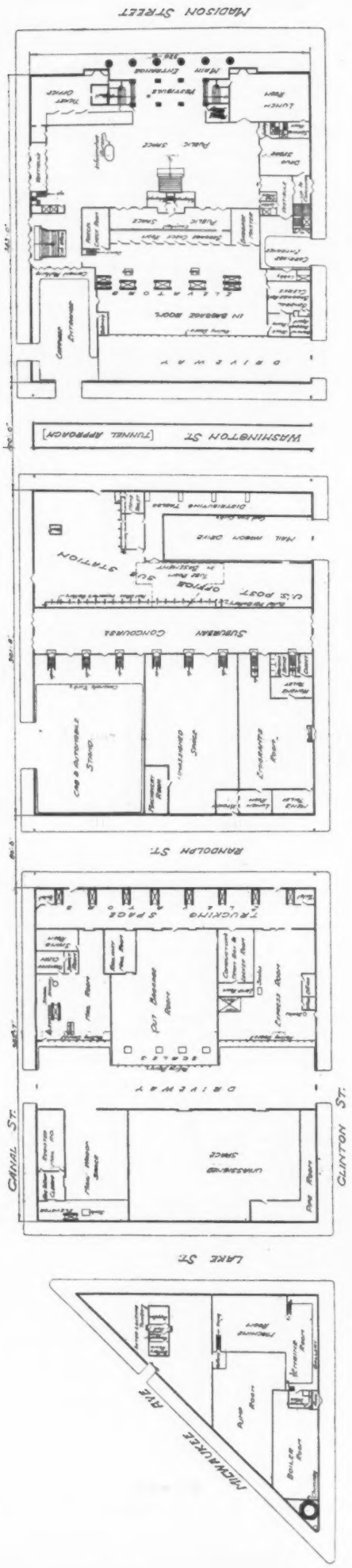


Fig. 1—View Showing (at the left) Exhaust Turbo-Generator, with Motor Generators in the Background.

The boiler-room is placed on the Clinton Street side of the power house, the floor being 21 ft. below the sidewalk level, with the roof 73 ft. above the floor. The main engine-room proper is also on the Clinton Street side of the building, south of the boiler-room. The total width available for the installation of the machinery was 40 ft. from the lot line to the steel girders of the track elevation. The engine-room floor is slightly over 10 ft. below the sidewalk level; the crane rails are 47 ft. 8 in. above the floor, while the ceiling of the engine-room, due to the pitch of the roof, varies between 60 ft. and 67 ft. above the floor, this giving an unusually high engine-room, but one which is at the same time well proportioned.

THE CHIMNEY AND ITS LIGHTNING PROTECTION.

Built of Custodis radial brick, the chimney for the power house rises 225 ft. above the sidewalk and about 245 ft. above the furnace grates. The inside diameter at the base is 11 ft. and at the top 10 ft. 6 in. The stack rests on three caissons carried down to rock. It is surmounted by a very heavy cast-iron cap and is protected by four light-


MADISON STREET
WASHINGTON ST
RANDOLPH ST.
CANAL ST.
CLINTON ST.
LAKE ST.
MICHIGAN AVE.
DRIVEWAY
TRUCKING SPACE
SUBURBAN CONCOURSE
STATION
POST OFFICE
MAIL CHUTE
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tile wainscoting the interior of the power house presents a handsome appearance, indicating, what is indeed the fact, that great attention has been paid to detail through the entire equipment. In the boiler plant there are six Bab-

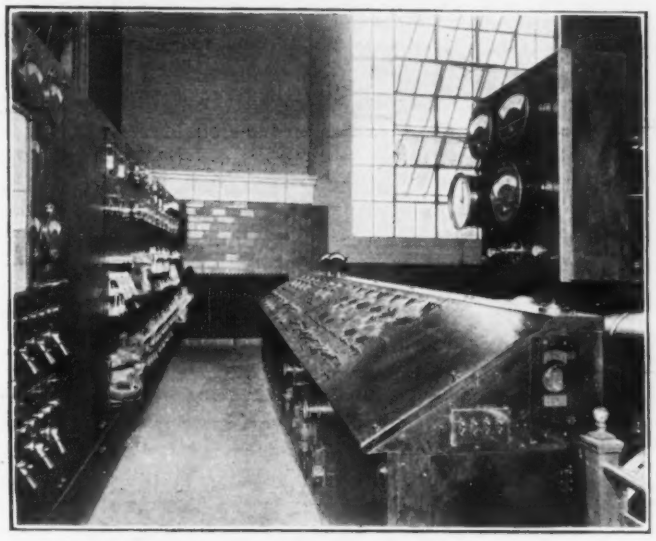


Fig. 5—Power House Switchboards. Bench Board for Control and Vertical Board for Distribution.

cock & Wilcox 500-hp water-tube boilers having vertical headers and being built for 200 lb. working pressure. Each boiler is equipped with superheaters of the Foster type and with Green mechanical stokers.

The coal and ash-handling apparatus was supplied by the Link-Belt Company. There are continuous pivoted bucket conveyors for handling both coal and ashes. Pan-type conveyors are used for conveying the coal from the cars to the bucket conveyor, and an inclined pan-type conveyor is used for conveying ashes to the ash-storage bins.

Special means are provided for taking care of expansion in the boiler breeching, which is supported on saddles and springs resting on the building I-beams, allowing free movement with varying temperatures. The piping layout also is noticeably simple and direct, a minimum amount of piping being used.

In the main engine-room there are three vertical cross-compound non-condensing Allis-Chalmers engines, each rated at 1150 hp, at 100 r.p.m., with steam pressure at 155 lb. and 70 deg. superheat. Each of these engines is direct-connected to a 750-kw, 250-volt, direct-current compound-wound General Electric generator, and space has also been left for a fourth generating unit of the same size. The engine platforms of all the vertical engines are interconnecting. Fig. 4 is a general view of the main engine-room. Automatic engine stops are provided for emergency use. One set of switches for operating these emergency stops is shown at the end of the benchboard in Fig. 5.

Alternating current is obtained by means of two motor-generator sets, each consisting of a 250-volt direct-current motor turning at 720 r.p.m., driving a 500-kw, 6600-volt, three-phase, 60-cycle generator. Each motor-generator set has its own direct-connected exciter unit. A three-wire balancer set, rated to care for 300 amp of unbalanced load, is also provided.

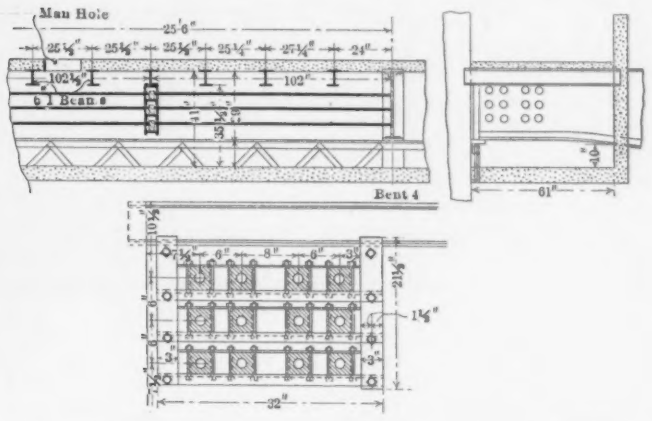


Fig. 7—Sections Showing Details of Cable Supports Between Girders in Cableway.

EXHAUST-STEAM TURBINE.

One of the most interesting features of the power plant is a Curtis low-pressure steam-turbine and generator unit, rated at 500 kw and producing 250-volt direct current, operating at 1500 r.p.m. Space has also been provided for an additional turbo-generator unit of the same size. Fig. 1 shows the turbine unit (at the left) and also the motor-generators in the background.

As it was impracticable to obtain a source of condensing water the main generating units are non-condensing and the exhaust from these Corliss engines, as well as from the various steam auxiliaries, is used in the low-pressure turbine. At the present season of the year, when steam is not needed for heating, the exhaust turbine takes about 40 per cent of the load on the station. It "floats" on the

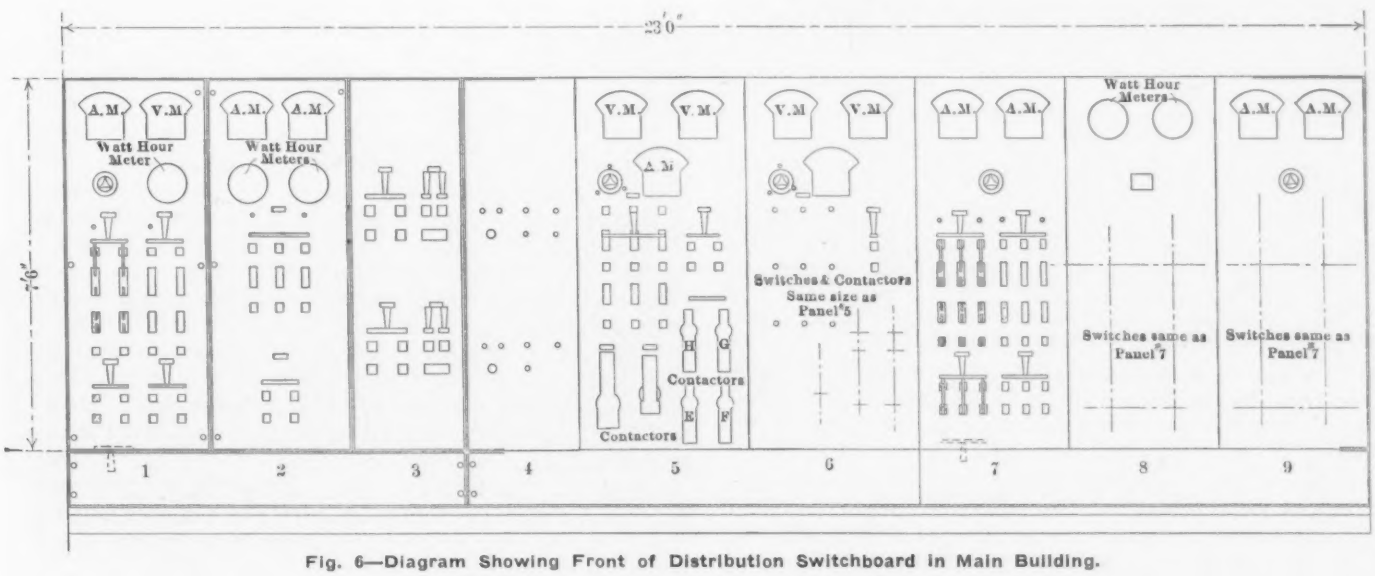


Fig. 6—Diagram Showing Front of Distribution Switchboard in Main Building.

system, there naturally being more exhaust steam as the load grows heavier. The Corliss engine sets are guaranteed to run on 18.6 lb. of steam per indicated horse-power at full load, against 16.5 lb. absolute back pressure. This means 21,400 lb. of steam exhausted to the low-pressure turbine. The latter was installed under a guarantee to deliver a kw-hour on 43.5 lb. of exhaust steam. Using the 21,400 lb. of steam exhausted from the engine unit, the turbine will develop an additional 786 hp, making a total of 1936 hp for the combined outfit on 21,400 lb. of steam, or a hp-hour from 11.8 lb. steam. The turbine will undoubtedly be operated at least eight months in the year, and very likely all the year around. This is believed to be the first power plant with an exhaust-steam turbine installed as part of the original installation.

OTHER POWER-HOUSE FEATURES.

The engine-room is spanned by a Shaw three-motor overhead traveling crane of 25 tons rating. There are also a Worthington condenser and a roof-type cooling tower for the turbo-generator. This cooling tower is equipped with four fans, driven by two 25-hp motors. In the "machine-room," which contains the turbine and the motor-generators, there are also two Ingersoll-Rand two-stage air compressors, each large enough to compress 500 cu. ft. of air per minute to 100 lb. pressure. A 3000-hp Webster feed-water heater and two Epping-Carpenter boiler-feed pumps are included in the equipment.

The present capacity of the generating plant is considered to be 2750 kw—that is, three 750-kw engine-driven generators and one 500-kw exhaust turbine unit. The ultimate plant will have a rating of 4000 kw. Direct current distributed on the 110-220-volt three-wire system is used entirely throughout the terminal, the alternating current from the motor-generator sets being used for supplying energy for lighting, signaling and power purposes on various suburban lines of the Chicago & Northwestern Railway.

CONTROL AND DISTRIBUTION OF ELECTRICITY.

In a switchboard gallery at the south end of the engine-room are the operating switchboard, which is of the bench-board type, and a vertical switchboard for the feeder panels. These switchboards, which were built by the Walker Electric Company, are illustrated in Fig. 5. Inasmuch as the terminal property is divided into four sections by the crossing streets, it seemed best to arrange the electrical distribution in the following manner:

Starting at the power house back of the benchboard on the switchboard gallery is placed the main feeder board, from which all feeders are run. One set of feeders runs to a distributing switchboard in the basement of the main building of the terminal, while another set runs to the switchboard in the machinery room just south of Randolph Street, under the elevated tracks, as shown on the plan.

For furnishing energy for motors and lamps in the main building there have been provided twelve 2,000,000 circ. mil cables. These are placed in a runway immediately above the train sheds on the Clinton Street side of the terminal. That portion of the cables leading from the switchboard to the runway is rubber-covered. Where the cables enter the runway they are incased in weather-proof triple braid and are threaded through holes in the roof girders resting on asbestos wooden blocks, porcelain bushings being provided in each case. In addition, two additional supports are provided between girders, as the distance, 26 ft., was considered too long to enable the cables to be supported as rigidly as desired. Fig. 7 shows the details of these cable supports between girders. To hold these transmission cables taut there has been provided at the north and south end of the cableway a special device made as follows:

An asbestos board 2 in. in thickness, with 3-in. holes drilled to correspond with the holes in the girder, is placed against the steel work, and after the cable is pulled up the insulation is stripped and a standard 2-in. shaft coupling clamped to the cable, thus firmly securing the cables and permitting a minimum amount of sag between supports. After being placed these couplings were thoroughly taped. At the south end of the cableway rubber-covered cables are connected to the transmission cables, these passing through conduits to the distributing switchboard located

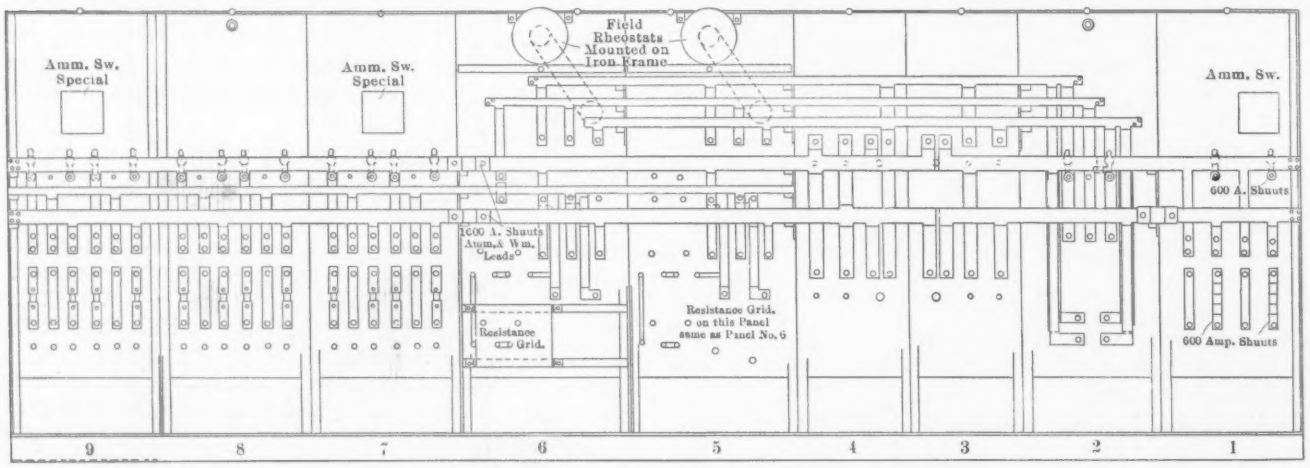


Fig. 8—Diagram of Rear of Distribution Switchboard in Main Building.

in what is known as the switchboard-room in the basement of the main building.

Four of these cables are connected through double-pole switches to the main lighting buses. Two of them are connected directly through a double-pole switch with power buses. Two are connected through a double-pole switch to train-lighting buses and the remaining four cables are connected as follows:

The two positive and the two negative cables are each connected separately to a special plate forming part of a switch made up with two separate blades, each with its own handle. The arrangement permits of one set being thrown either to the general lighting buses or the train-lighting buses, while the other connection may be made either to the power buses or general lighting buses. This arrangement may be understood more clearly by reference to Figs. 6 and 8, showing, respectively, the connections on the front and rear of the distributing switchboard in the basement of the main building.

FEEDER REGULATION.

Feeder regulation is effected by special switching arrangements. During the daytime and until the concealed lamps in the main waiting-room are required one feeder cable is disconnected from the distributing board and at

the same time separate feeder switches controlling the concealed lamps in the waiting-room are opened. At the same time the switches in the train-lighting feeders are

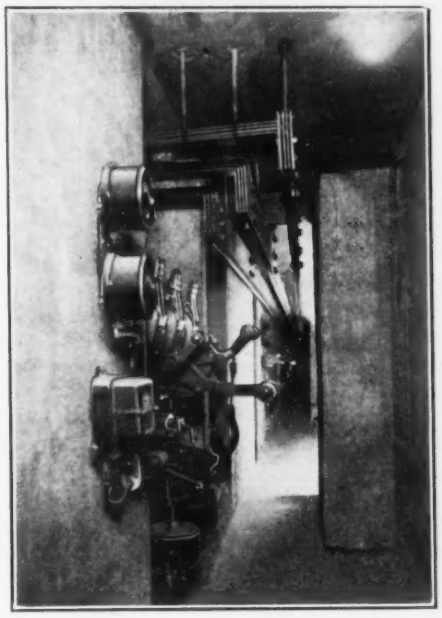


Fig. 9—Busbar Tunnel Under Engine Room. Showing 4000-Amp. Circuit Breaker.

opened, for the train-lighting load does not come on until late in the evening. By this means one set of feeders takes care of practically 110 kw to 135 kw.

In practice the result is that when the lighting is on in the main building two sets of feeders are in service for lamps and two for motors, another set being thrown in when the train lighting is required and still another when the concealed lamps in the waiting-room are lighted. The records show that there is a variation of only from 0.3 volt

Fig. 10—View in Pit Beneath Motor Generator and Turbine Sets Showing Circuit Breakers, Busbars and Rheostats.

to 0.8 volt between no load and full load. These variations would naturally be dependent upon the load and the cables that are in service.

Electrical energy for lamps and motors in the two blocks or sections of the terminal between Washington Street and Lake Street is controlled from the board in the machine-room on the south side of Randolph Street under the tracks, to which reference has been made. In this machine-room there is a balancer set rated for 300 amp, unbalanced load. This is interconnected with the balancer in the power house, and by suitably arranged switches one may act as a relay to the other. Lighting and motor service for the power house itself is furnished directly from the main feeder board.

REMOTE CONTROL.

In the power house the remote-control feeders in connection with the alternating-current apparatus are substantially the same as those in general use for 6600-volt work. In connection with the direct-current apparatus the control has been somewhat elaborated, owing to special conditions existing in the plant, such as the controlling of

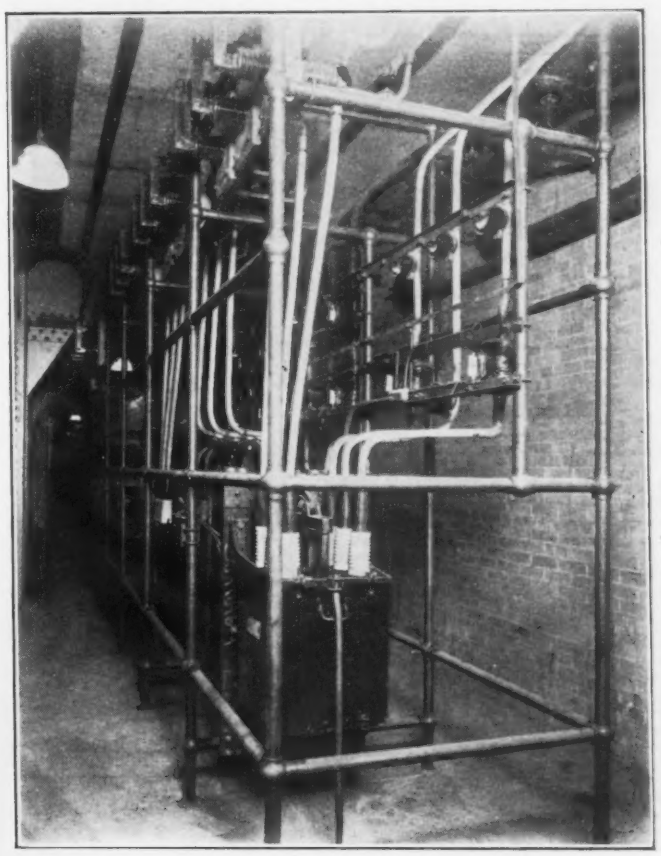


Fig. 11—Oil-Switch Room.

the motor-generator sets from the direct-current end and the operation of circuit-breakers as line switches connecting the various direct-current generators with the system of buses.

The remote-control circuit-breakers for the 750-kw direct-current generators have a nominal rating of 4000 amp. They are installed in recesses in the engine foundations in a tunnel beneath the engine-room floor shown in Fig. 9. By placing these breakers in this manner the switchboard is simplified and the flexibility of the system is increased, for the switching apparatus of each individual unit is placed near it.

Remote-control switches on the benchboard in the switchboard gallery control all of the various circuit-breakers of the direct-current generators and those installed in connection with the motors of the motor-generator sets. In addition, the oil switches for the high-tension end of the motor-generator sets, as well as the oil switches for the outgoing alternating-current feeders, are similarly operated by remote-control switches.

The 4000-amp circuit-breakers for the engine-driven generators and the 3000-amp circuit-breaker for the turbo-

generator are three-pole, 250-volt, two-coil, overload, Reversite, Dalite and Auto-ite, motor-operated, remote-control I-T-E breakers. They are electrically and mechanically interlocking and close without jar, as instantly upon the beginning of the closing movement the control switch is automatically short-circuited by the closing mechanism and the movement thus completed without further action on the part of the operator. The circuit-breakers used in connection with the motors of the motor-generators are of the same general type, but are single-pole, two being installed for each motor. Fig. 10 is a view in the pit beneath the turbine and motor-generators, where these breakers are installed. By closing the control switch on the benchboard one of these single-pole breakers is closed, thus permitting current to pass through the contactors, closing one after the other of the automatic motor starters, the closing of the last contactor automatically closing the short-circuiting motor-operated switch or circuit-breaker.

Resistances have been placed in series with the field of each of the motors of the motor-generator sets, so as to permit of synchronizing, the benchboard being equipped with synchronizing devices.

All of the generators are equipped with electrically operated rheostats controlled from the benchboard. The exciters for the alternating-current generators of the motor-generator sets are connected directly to the buses without any circuit-breakers or fuses, remote-control switches on the benchboard bringing into operation contactors which connect the exciters to the buses.

As each exciter is directly connected to the shaft of its motor-generator set it was necessary to devise some arrangement whereby accidental manipulation of the remote-control switch on one of the "dead" exciters, in case only one machine was running, would not cause a short-circuit when throwing the "dead" exciter onto the buses as a motor. This is accomplished by placing in one of the legs of each of the exciter connections a reverse-current relay which acts upon reversal of current and closes the circuit through an auxiliary relay placed on the benchboard. This auxiliary relay opens the circuit through the closing coil of the contactor connecting the exciter to the exciter buses and at the same time closes a bell circuit, thus indicating to the operator that the "dead" exciter has been thrown onto the buses.

Inasmuch as remote control is relied upon entirely, it was not feasible to use the ordinary field switch in connection with the opening of the field circuit of the alternating-current generators. The special arrangement worked out here consists of placing a connection on the extended shaft of the remote-control switch in the form of a triangular contact which will enter the blades when the switch is opened. These blades close the circuit through the closing coil of a small contactor which connects the discharge resistance across the fields of the alternating-current machine.

OIL-SWITCHING EQUIPMENT.

The high-tension oil switches for the alternating-current service north of the power house are placed in a separate room, as illustrated in Fig. 11. General Electric three-pole, 300-amp, 15,000-volt oil switches are used and they have tripping devices adjusted automatically to open the switch on a predetermined overload or "short" on the outside lines, or from the control switch on the feeder panel of the distributing board when it is desired to open the circuit. A wiring diagram of alternating-current connections is given in Fig. 12.

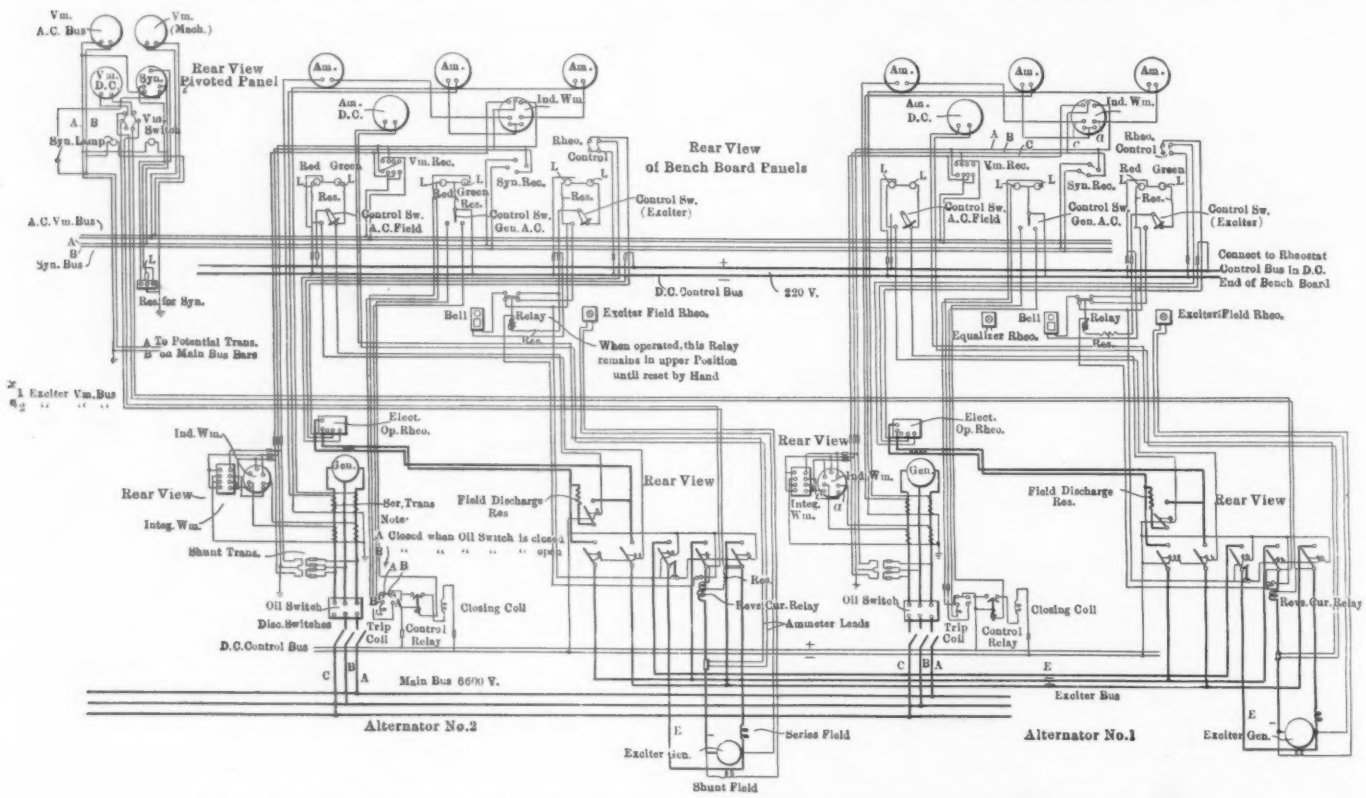


Fig 12—Wiring Diagram of Alternating-Current Instrument and Control Circuits in Power House.

AUTOMATIC CONTROL OF BALANCER.

For the under-track requirements of the block between Washington Street and Randolph Street there is provided a remote-control, 500-amp, two-pole switch for connecting the feeder lines to the mains. This switch is operated automatically. To start the balancer set a knife switch is closed and when the balancer set comes up to speed a contactor connects the neutral of the balancer set to the neutral busbar, this in turn closing the second neutral contactor connecting the neutral main of the three-wire system to the neutral bus at the switchboard. When this last contact is made connections are effected to energize coils on the 500-amp remote-control switch connecting the two outside legs of the system. It will thus be seen that it is impossible to close the outside legs of the three-wire

system until the balancer set is brought up to speed and ready to take its load, when the contactor in the neutral main is closed.

PERSONNEL.

The Northwestern Passenger Terminal was planned while Mr. Marvin Hughitt was president of the Chicago & Northwestern Railway Company, and he took an intimate and personal interest in the details of the electrical and mechanical equipment. The direct supervision of the work, however, was in charge of Mr. John M. Whitman, vice-president of the railway company in charge of construction. All engineering details were passed upon by the chief engineer of the company, Mr. E. C. Carter. Frost & Granger were the architects and Pierce, Richardson & Neiler were the designing and consulting engineers, to whose ingenuity the numerous special forms of equipment found in this terminal are due. Kohler Brothers were the electrical contractors. Mr. F. J. Ravlin is the engineer in charge of operation of the terminal power plant.

A RESISTANCE METHOD FOR OBSERVING THE INSTANTANEOUS PERFORMANCE OF INCANDESCENT LAMPS.

BY EVAN J. EDWARDS AND GEORGE C. CONNER.

Considerable attention has been given recently to the question of cyclic variations of luminous intensity in incandescent lamps.* Therefore a method which is in some particulars new in its application to this particular problem may be of interest at this time.

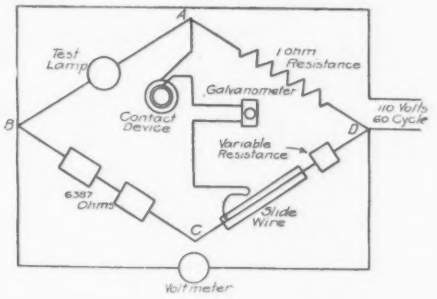


Fig. 1—General Arrangement of Bridge.

The luminous intensity, temperature and resistance of filaments are interdependent. They are functions of one another, which in no way involve time. That such is the case can hardly be doubted. There is nothing about the performance of a lamp that would lead one to think otherwise and there is much evidence to substantiate the above statement. It is a significant and convincing fact in this connection that the angle of lag of luminous intensity behind voltage as obtained photometrically, by the method of this paper, which is a resistance method, and that obtained by computation check within reasonable limits of accuracy.

The relation between luminous intensity and resistance can be accurately determined under constant conditions with direct current. Therefore, it is necessary only to measure the variations in resistance in order to know the variations in luminous intensity.

*Papers recently published which have a bearing on this subject are: "Measurement of Instantaneous Lamp Resistance," by Frederick Bedell, *Electrical World*, Feb. 9, 1911; "Effect of Wave Form Upon Incandescent Lamps," by M. G. Lloyd, *Elec. Review and Western Elec.*, Jan. 14, 1911; "Effect of the Forms of Emf Waves Upon the Life and Efficiency of Incandescent Lamps," by Prof. Kinsloe, Bulletin No. 1, Penn. State Coll. Exp. Station, extract in *Electrical World*, Nov. 17, 1910; "Relative Efficiency of Light Production by Constant-Temperature and Variable-Temperature Incandescent-Lamp Filaments," by E. J. Edwards, *Electrical World*, Feb. 16, 1911; "Fluctuation of Temperature of Alternating-Current Lamps," by O. M. Corbino, *Phys. Zeit.*, April 15, 1911; "Effect of Frequency on the Variation of Candle-Power of Incandescent Lamps," abstract of thesis by Messrs. Kiely and Wasserboehr, *Electrical World*, Feb. 16, 1911.

It is the purpose of this paper to describe a method for measuring the resistance of a lamp at any point in the cycle and to give the results of a few tests.

The apparatus used was essentially a Wheatstone bridge with non-inductive resistances and a synchronous contact device in the galvanometer circuit, as shown in Fig. 1. In the early part of the work one contact per candle-power cycle was used, with a telephone receiver instead of the galvanometer. This arrangement was difficult to operate because of the interference of stray fields. The final arrangement was one contact per electrical cycle and a d'Arsonval galvanometer. The one contact per electrical cycle, of course, furnishes the galvanometer with unidirectional impulses of current when the bridge is out of balance, and the impulses are changed in direction when passing through the zero current point of the wave. The latter fact furnishes a means for very accurately determining the zero current and voltage point in the cycle. It was found that by throwing the bridge considerably out of balance it was possible to determine the zero point to within 1 deg. The segments on the contact device were made wedge-

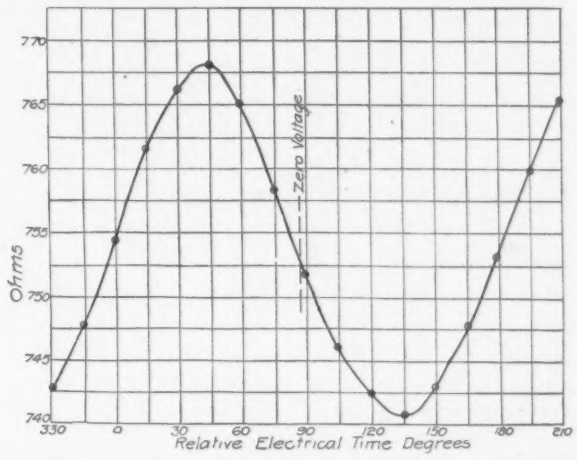


Fig. 2—Resistance Variation of 15-Watt, 110-Volt, 60-Cycle Tungsten Lamp.

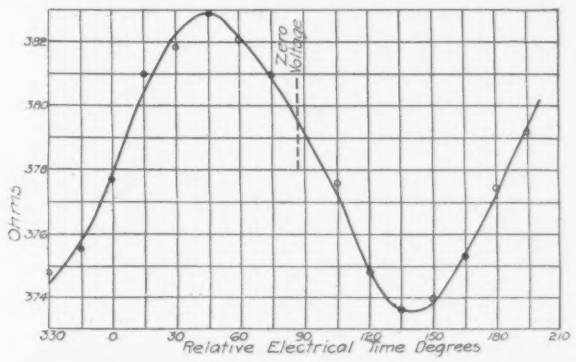


Fig. 3—Resistance Variation of 25-Watt, 110-Volt, 60-Cycle Tungsten Lamp.

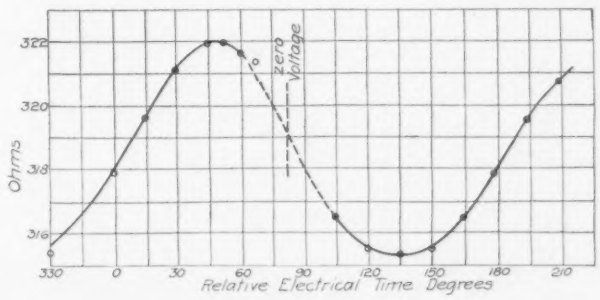


Fig. 4—Resistance Variation of Tungsten Filament Lamp, 40 Watts, 110 Volts, 60 Cycles, Special Spring Hooks.

shaped to allow of varying the duration of contact by moving the brush laterally.

Results of tests on several lamps at 60 cycles are given in Table I, and Figs. 2-9. The curve of Fig. 9 is a

TABLE I.—TEST DATA.

Lamp.	Normal Watts.	Volt Class.	Normal Resistance.	Per Cent Change in Resistance from Normal.	Calculated Change in Candle-Power.	Measured Change by Kiely & Wasserboehr.
Tungsten filament..	15	110	755	3.56	36.0	....
Tungsten filament..	25	110	378	2.47	23.9	22.5
Tungsten filament..	40	110	324	2.15	20.6	20.5
Tunstgen filament..	60	110	208	1.73	16.6	14.1
Tantalum.....	25	110	510	1.53	25.6	....
Graphitized carbon..	40	110	296	0.47	10.4	....
Treated carbon.....	50	110	234	0.26 (?)	20.0 (?)	....
Untreated carbon....	60	220	773	0.80	19.2	....

sample candle-power curve computed from the resistance curve of Fig. 2, using the relation.

$$T = R^{3.8}$$

where T is the candle-power and R is the resistance, both expressed as their ratio to normal value. The curve has been shifted from relative to actual electrical time degrees. The exponent 3.8 is an average value for tungsten-filament lamps. The value for the particular lamp used could as well have been determined with precision had it been highly desirable to get most accurate data on that one lamp. The approximate values of the exponent for various types of lamps are given in Table II.

It will be seen from the resistance curves that the method affords an accurate means of getting at the instantaneous

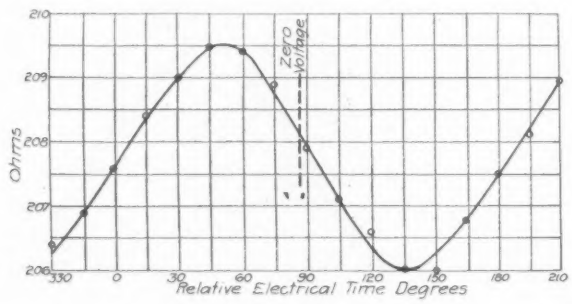


Fig. 5—Resistance Variation of 60-Watt, 110-Volt, 60-Cycle Tungsten Lamp.

performance of a lamp. This is especially true of tungsten-filament lamps because of the relatively large change in resistance corresponding to a given change in candle-power. As will be seen in Table II, the method is not so well adapted to treated-carbon lamps because of the very small

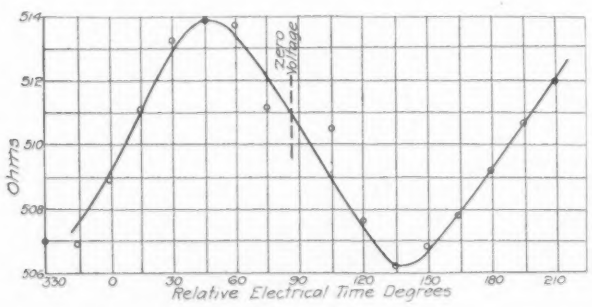


Fig. 6—Resistance Variation of 25-Watt, 110-Volt, 60-Cycle Tantalum Lamp.

change in resistance for a given change in candle-power.

Fortunately the method gives good precision at the points in the cycle where the information is most valuable, that is, at the maximum and minimum values of resistance and luminous intensity. The precision is low around 90 deg. as given on the curves because of the low voltage and consequent low sensibility of the bridge in that region.

It is interesting to note that candle-power variations as

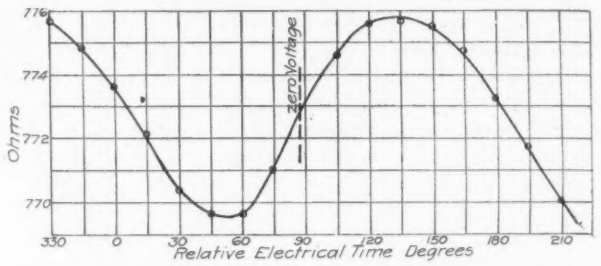


Fig. 7—Resistance Variation of 60-Watt, 220-Volt, 60-Cycle Untreated Carbon-Filament Lamp.

obtained by this method agree reasonably well with those obtained stroboscopically by Kiely and Wasserboehr, and

TABLE II.—EXPONENTS FOR RESISTANCE-CANDLE-POWER EQUATIONS.

Filament Material.	Exponent.
Tungsten.....	3.8
Tantalum.....	15
Graphitized carbon.....	21
Treated carbon.....	—74
Untreated carbon.....	—22

also that the value for the angle of lag of candle-power behind voltages agrees within reasonable accuracy with that obtained by Kiely and Wasserboehr and with the

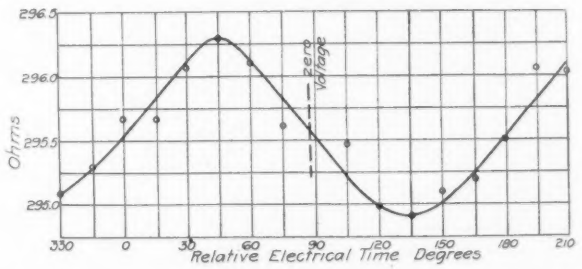


Fig. 8—Resistance Variation of 40-Watt, 108-Volt, 60-Cycle Graphitized Carbon Lamp.

computed values given in an article, "Relative Efficiency of Light Production by Constant-Temperature and Variable-Temperature Incandescent-Lamp Filaments." Both articles are referred to in the footnote.

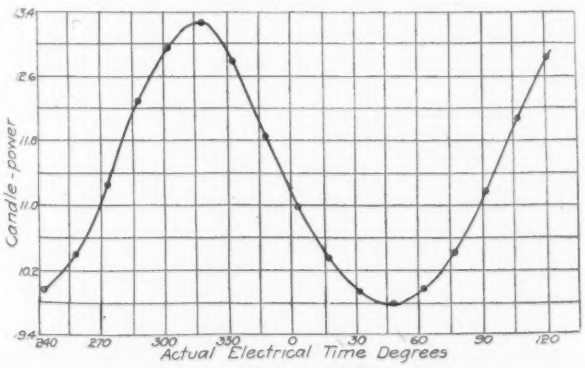


Fig. 9—Candle-Power Variation of Special 15-Watt, 110-Volt, 60-Cycle Tungsten Lamp.

The instantaneous-resistance method affords a very convenient and simple means for investigating the effect of various wave forms and frequencies on the performance of incandescent lamps.

THE CALCULATION OF CAPACITY COEFFICIENTS FOR PARALLEL SUSPENDED WIRES—II.

BY FRANK F. FOWLE.

In the issue dated Aug. 12 was given a solution of the problem relating to the capacity coefficients for grounded circuits. Below is given a treatment of the cases involving metallic circuits.

METALLIC CIRCUITS.

A general solution for the case of any number of metallic circuits is not possible unless the number of wires composing each group or metallic system is given. The general case in its simplest form deals with two-wire metallic circuits, so that the number of wires considered is always even. But every metallic circuit is subject to the special condition that the charges on its respective members are equal and opposite, since the wires are charged from a single emf source. This can be expressed as

$$q_x = -q_{x+1} \tag{56}$$

where x is an odd integer and the pairs are numbered 1-2, 3-4, 5-6, etc. If the fundamental equations are of the form

$$\left.\begin{aligned} V_1 &= u_{11}q_1 + u_{12}q_2 + u_{13}q_3 + u_{14}q_4 + \ldots + u_{1n}q_n \\ V_2 &= u_{12}q_1 + u_{22}q_2 + u_{23}q_3 + u_{24}q_4 + \ldots + u_{2n}q_n \\ V_3 &= u_{13}q_1 + u_{23}q_2 + u_{33}q_3 + u_{34}q_4 + \ldots + u_{3n}q_n \\ V_4 &= u_{14}q_1 + u_{24}q_2 + u_{34}q_3 + u_{44}q_4 + \ldots + u_{4n}q_n \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \tag{57}$$

they can obviously be rewritten, using, for example, q_{12} in place of q; the results will be n equations having $\frac{n}{2}$ terms in the second members, as given by (58).

$$\left.\begin{aligned} V_1 &= (u_{11} - u_{12})\,q_{12} + (u_{13} - u_{14})\,q_{34} + \ldots \\ &\quad + (u_{1(n-1)} - u_{1n})\,q_{(n-1)n} \\ V_2 &= (u_{12} - u_{22})\,q_{12} + (u_{23} - u_{24})\,q_{34} + \ldots \\ &\quad + (u_{2(n-1)} - u_{2n})\,q_{(n-1)n} \\ V_3 &= (u_{13} - u_{23})\,q_{12} + (u_{33} - u_{34})\,q_{34} + \ldots \\ &\quad + (u_{3(n-1)} - u_{3n})\,q_{(n-1)n} \\ V_4 &= (u_{14} - u_{24})\,q_{12} + (u_{34} - u_{44})\,q_{34} + \ldots \\ &\quad + (u_{4(n-1)} - u_{4n})\,q_{(n-1)n} \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \tag{58}$$

However, this case deals with differences of emf and hence V_2 can be subtracted from V_1 and V_4 from V_3, etc. If, in general,

$$V_{xy} = V_x - V_y \tag{59}$$

then equation (58) can be reduced to $\frac{n}{2}$ in number with $\frac{n}{2}$ terms in the second members. The expression for V_{12}, for example, becomes,

$$V_{12} = (u_{11} - 2u_{12} + u_{22})\,q_{12} + (u_{13} - u_{14} - u_{23} + u_{24})\,q_{34} + \ldots \tag{60}$$

and the expression for V_{34} is,

$$V_{34} = (u_{13} - u_{23} - u_{14} + u_{24})\,q_{12} + (u_{33} - 2u_{34} + u_{44})\,q_{34} + \ldots \tag{61}$$

These expressions are too cumbersome to give in full, or to employ in the subsequent treatment. Therefore, a new type of coefficient will be adopted, so that (60), (61) and the remaining equations obtained from (58) by similar operations could be expressed as given by (62).

$$\left.\begin{aligned} V_{12} &= P_{1212}q_{12} + P_{1234}q_{34} + P_{1256}q_{56} + \ldots \\ V_{34} &= P_{1234}q_{12} + P_{3434}q_{34} + P_{3456}q_{56} + \ldots \\ V_{56} &= P_{1256}q_{12} + P_{3456}q_{34} + P_{5656}q_{56} + \ldots \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \tag{62}$$

The new coefficients are

$$\left.\begin{aligned} P_{1212} &= u_{11} - 2u_{12} + u_{22} \\ P_{1234} &= u_{13} - u_{14} - u_{23} + u_{24} \\ P_{3434} &= u_{33} - 2u_{34} + u_{44} \\ P_{1256} &= u_{15} - u_{16} - u_{25} + u_{26} \\ P_{3456} &= u_{35} - u_{36} - u_{45} + u_{46} \\ P_{5656} &= u_{55} - 2u_{56} + u_{66} \end{aligned}\right\} \tag{63}$$

In general any coefficient of the new type can be expressed as,

$$P_{(xy)(mn)} = u_{xm} - u_{xn} - u_{ym} + u_{yn} \tag{64}$$

where the system of numbering the subscripts hitherto employed is rigidly followed. Then the new set of $\frac{n}{2}$ equations can be solved by the method of determinants, just as in the general case of n grounded wires. If,

$$D = \left\{\begin{matrix} P_{1212}, & P_{1234}, & P_{1256} & \ldots \\ P_{1234}, & P_{3434}, & P_{3456} & \ldots \\ P_{1256}, & P_{3456}, & P_{5656} & \ldots \\ \ldots\ldots\ldots & \ldots\ldots\ldots & \ldots\ldots\ldots & \\ \ldots\ldots\ldots & \ldots\ldots\ldots & \ldots\ldots\ldots & \end{matrix}\right\} \tag{65}$$

any coefficient of capacity is given by the expression

$$C_{(xy)(mn)} = \frac{D'}{D} \tag{66}$$

where D' is that minor of D which gives the coefficient of $P_{(xy)(mn)}$ in the expansion of D; the rule for finding the desired minor is well known and need not be repeated.

The general case is quite parallel to the case of n grounded wires, although a trifle more involved. The discussion of specific cases is of much interest and value and will next be taken up.

Two Wires.—The general case as presented above gives at once the result

$$V_{12} = (u_{11} - 2u_{12} + u_{22})\,q_{12} \tag{67}$$

and hence

$$C_{12} = \frac{1}{u_{11} - 2u_{12} + u_{22}} \tag{68}$$

$$= \frac{1}{2\log\frac{2h_1}{r_1} - 4\log\frac{h_{12}}{d_{12}} + 2\log\frac{2h_2}{r_2}} \tag{69}$$

or finally

$$C_{12} = \frac{1}{2\log\frac{4h_1h_2d^2_{12}}{r_1r_2h^2_{12}}} \tag{70}$$

where the wires are at heights h_1 and h_2, respectively, above the earth, separated by the distance d_{12}, the image of one distant h_{12} from the opposite real wire and the respective radii of the wires r_1 and r_2. This is the most general expression for the metallic capacity of a single pair of wires, of any sizes and spaced in any way. If the wires are of equal size and at equal heights above the earth the expression in (70) becomes

$$C_{12} = \frac{1}{2\log\frac{4h^2d^2}{r^2(d^2+4h^2)}} \tag{71}$$

If the pair of wires is elevated to a point so far from the earth that $\frac{4h^2}{(d^2+4h^2)}$ is practically unity, expression (70) becomes

$$C''_{12} = \frac{1}{2\log\frac{d^2}{r_1r_2}} \tag{72}$$

and in the same case (71) becomes

$$C'''_{12} = \frac{1}{4\log\frac{d}{r}} \tag{73}$$

which is the most familiar expression for the capacity of a metallic pair.

Expressions (70) and (71) differ from (72) and (73), respectively, in the fact that the former include the effect of the electrical image of the pair, beneath the earth's surface, while the latter do not. As will be shown by concrete examples, the effect of the image is negligible in most practical cases because d is small compared with h and again

because the two wires of the pair are equally but oppositely charged.

Consider the case of two No. 8 B. W. G. wires spaced 1 ft. apart and each 20 ft. above the earth. Then,

$$\left.\begin{aligned} h_1 = h_2 &= 20 \text{ ft.} \\ d &= 1 \text{ ft.} \\ r_1 = r_2 &= 0.0825 \text{ in.} \end{aligned}\right\} \tag{74}$$

and by computation

$$\left.\begin{aligned} C'_{12} &= 0.008980 \text{ microfarad per mile} \\ C'''_{12} &= 0.008979 \text{ microfarad per mile} \end{aligned}\right\} \tag{75}$$

In this case $\frac{4h^2}{d^2+4h^2}$ differs from unity by less than one part in 1000, and hence is entirely negligible. The final difference between the capacities is only 0.011 per cent. If the pair is lowered to an elevation of 5 ft. the results are as given by (76).

$$\left.\begin{aligned} C'_{12} &= 0.008989 \\ C'''_{12} &= 0.008979 \end{aligned}\right\} \tag{76}$$

The increase in the second case due to the image is only 0.11 per cent and is again practically negligible. If lowered still more, to an elevation of 3 ft., with the same horizontal separation of 1 ft., the increase due to the image is about 0.28 per cent. These cases show clearly that with metallic circuits as commonly employed in energy or intelligence transmission the images may be neglected. This, however, does not permit a direct cancellation of any of the potential coefficients.

It is also interesting to observe a connection between the grounded capacities given by (34) and (35) and the expression (71). Heaviside shows in general how the theory of transmission over a metallic circuit may be derived from the consideration of mutual interference or induction between two grounded circuits when the impressed emfs are equal but opposite in phase. In this case the proper capacity coefficient for the metallic circuit is

$$C'_{12} = \tfrac{1}{2}(C_1 - C_{12}) \tag{77}$$

and it will be found that this equation is satisfied by the substitution of (34) and (35) for C_1 and C_{12} respectively, which produce the result given in (71).

Four Wires, Two Circuits.—In this case the common denominator of the capacity coefficients is given by

$$D = \begin{Bmatrix} P_{1212}, & P_{1234} \\ P_{1234}, & P_{3434} \end{Bmatrix} \tag{78}$$

$$= P_{1212}P_{3434} - (P_{1234})^2 \tag{79}$$

$$= \left(2\log\frac{4h_1h_2d^2_{12}}{r_1r_2h^2_{12}}\right)\left(2\log\frac{4h_3h_4d^2_{34}}{r_3r_4h^2_{34}}\right) - \left(2\log\frac{h_{13}h_{24}d_{14}d_{23}}{d_{13}d_{24}h_{14}h_{23}}\right)^2 \tag{80}$$

and

$$C_{12} = \frac{2\log\dfrac{4h_3h_4d^2_{34}}{r_3r_4h^3_{34}}}{D} \tag{81}$$

$$C_{34} = \frac{2\log\dfrac{4h_1h_2d^2_{12}}{r_1r_2h^2_{12}}}{D} \tag{82}$$

$$-C_{1234} = \frac{2\log\dfrac{h_{13}h_{24}d_{14}d_{23}}{d_{13}d_{24}h_{14}h_{23}}}{D} \tag{83}$$

If the wires are all of the same size and the effect of the images is neglected, the results are simplified to,

$$D = \left(4\log\frac{d_{12}}{r}\right)\left(4\log\frac{d_{34}}{r}\right) - \left(2\log\frac{d_{14}d_{23}}{d_{13}d_{24}}\right)^2 \tag{84}$$

$$C'_{12} = \frac{4\log\dfrac{d_{34}}{r}}{D} \tag{85}$$

$$C'_{34} = \frac{4\log\dfrac{d_{12}}{r}}{D} \tag{86}$$

$$-C'_{1234} = \frac{2\log\dfrac{d_{14}d_{23}}{d_{13}d_{24}}}{D} \tag{87}$$

When the pairs differ in wire size, but the image effect is neglected, the formulas are obvious from (80) to (83) and need not be given. In order to make the mutual capacity vanish it is necessary to fulfil the condition,

$$d_{14}d_{23} = d_{13}d_{24} \tag{88}$$

and at the same time the mutual inductance will vanish also. This condition when studied analytically shows how

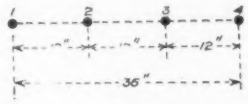


Fig. 9—Four Wires. Two Circuits.

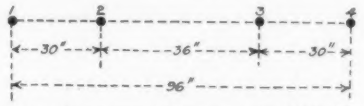


Fig. 10—Four Wires; Two Metallic Circuits.

to distribute four wires (in two pairs) in various ways to avoid mutual interference. The results of such a study, in both analytical and graphical form, have been given by the author[4] elsewhere and need not be repeated.

The image effect in this case, as in the last, is ordinarily negligible. The numerical values of the capacity coefficients in the case of four No. 12 N. B. S. G. wires lying in one plane, with an adjacent spacing of 12 in., as shown in Fig. 9, are given below.

The capacities have been calculated from expressions (84) to (87).

$$\left.\begin{aligned} C'_{12} = C'_{34} &= 0.008223 \text{ mfd per mile} \\ -C'_{1234} &= 0.0002174 \text{ mfd per mile} \end{aligned}\right\} \tag{89}$$

The capacity of either pair alone, from (73), would be

$$C'''_{12} = 0.008218 \tag{90}$$

which shows that the second circuit increases the capacity of the first by only 0.06 per cent. In general, the increase of coefficients of capacity for metallic pairs as other pairs are added to the system is wholly negligible. It is also noticeable that the mutual capacities are relatively much smaller in this case than in the general case of grounded circuits.

Another case has been calculated for the conditions shown in Fig. 10, employing No. 4 B. & S. gage conductors.

Using the same formulas in this case as in the last the results are,

$$\left.\begin{aligned} C'_{12} = C'_{34} &= 0.007626 \text{ mfd per mile} \\ -C'_{1234} &= 0.0001504 \text{ mfd per mile} \\ C'''_{12} &= 0.007623 \text{ mfd per mile} \end{aligned}\right\} \tag{91}$$

Again it is noticeable that the effect of circuit *3-4* in raising the capacity of *1-2* is insignificant. If wires of the

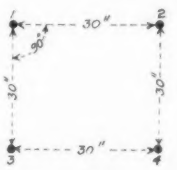


Fig. 11—Four Wires; Two Metallic Circuits.

same size as in the last case are rearranged, as shown in Fig. 11, the new capacities will be those given by (92).

$$\left.\begin{aligned} C'_{12} = C'_{34} &= 0.007648 \text{ mfd per mile} \\ -C'_{1234} &= 0.0004519 \text{ mfd per mile} \end{aligned}\right\} \tag{92}$$

As might be expected, the individual capacities have been increased slightly by the nearer proximity of the two circuits and the mutual capacity has about three times its previous value.

Four Wires, One Circuit.—Four wires are frequently

[4] "The Transposition of Electrical Conductors": *Proceedings* of the American Institute of Electrical Engineers, Vol. XXI.

arranged in one circuit, sometimes in energy distribution and again in phantom telephone lines. Referring in this case to Fig. 9, for example, wires *1* and *2* would form one side of the circuit and wires *3* and *4* the opposite side. The wires forming one side of the circuit are usually at the same impressed potential in any case.

The fundamental equations are the same as those in any case of four wires,

$$\left.\begin{aligned} V_1 &= u_{11}q_1 + u_{12}q_2 + u_{13}q_3 + u_{14}q_4 \\ V_2 &= u_{12}q_1 + u_{22}q_2 + u_{23}q_3 + u_{24}q_4 \\ V_3 &= u_{13}q_1 + u_{23}q_2 + u_{33}q_3 + u_{34}q_4 \\ V_4 &= u_{14}q_1 + u_{24}q_2 + u_{34}q_3 + u_{44}q_4 \end{aligned}\right\} \quad (93)$$

The nature of the case imposes the following set of conditions:

$$\left.\begin{aligned} V_1 &= V_2 \\ V_3 &= V_4 \\ (q_1 + q_2) &= -(q_3 + q_4) \end{aligned}\right\} \quad (94)$$

This reduces the number of independent equations in (93) to two, which can be written,

$$\left.\begin{aligned} V_1 &= (u_{11} - u_{14})q_1 + (u_{12} - u_{14})\,q_2 + (u_{13} - u_{14})\,q_3 \\ V_3 &= (u_{13} - u_{34})\,q_1 + (u_{23} - u_{34})\,q_2 + (u_{33} - u_{34})\,q_3 \end{aligned}\right\} \quad (95)$$

Taking the difference of the last two equations,

$$V_{13} = (u_{11} - u_{14} - u_{12} + u_{34})\,q_1 + (u_{12} - u_{14} - u_{23} + u_{34})\,q_2 + (u_{13} - u_{14} - u_{23} + u_{34})\,q_3 \quad (96)$$

Substituting the proper expressions for the potential coefficients and neglecting the image effect gives

$$V_{13} = \left(2\log\frac{d_{13}d_{14}}{r_1 d_{34}}\right)q_1 + \left(2\log\frac{d_{14}d_{23}}{d_{13}d_{34}}\right)q_2 + \left(2\log\frac{r_3 d_{14}}{d_{13}d_{34}}\right)q_3 \quad (97)$$

In order to shorten the expression it may be abbreviated as,

$$V_{13} = aq_1 + bq_2 + cq_3 \quad (98)$$

Now by subtracting V_2 from V_1 and V_4 from V_3, after eliminating q_4, it will be found that

$$-q_3 = \left(\frac{2\log\dfrac{d_{12}d_{14}}{r_1 d_{24}}}{2\log\dfrac{d_{14}d_{23}}{d_{13}d_{24}}}\right)q_1 + \left(\frac{2\log\dfrac{r_2 d_{14}}{d_{12}d_{24}}}{2\log\dfrac{d_{14}d_{23}}{d_{13}d_{24}}}\right)q_2 \quad (99)$$

or, abbreviating,

$$-q_3 = \frac{d}{e}q_1 + \frac{f}{e}q_2 \quad (100)$$

and

$$-q_3 = \left(\frac{2\log\dfrac{d_{14}d_{34}}{r_4 d_{13}}}{2\log\dfrac{d^2_{34}}{r_3 r_4}}\right)q_1 + \left(\frac{2\log\dfrac{d_{24}d_{34}}{r_4 d_{23}}}{2\log\dfrac{d^2_{34}}{r_3 r_4}}\right)q_2 \quad (101)$$

or, abbreviating again,

$$-q_3 = \frac{g}{h}q_1 + \frac{k}{h}q_2 \quad (102)$$

Substituting (100) in (98) gives

$$V_{13} = \left(a - \frac{cd}{e}\right)q_1 + \left(b - \frac{cf}{e}\right)q_2 = \left(\frac{ae - cd}{e}\right)q_1 + \left(\frac{be - cf}{e}\right)q_2 \quad (103)$$

Subtracting (102) from (100) to find q_2 in terms of q_1,

$$-q_2 = \left(\frac{dh - ge}{fh - ek}\right)q_1 \quad (104)$$

and substituting (104) in (103)

$$V_{13} = \left[\begin{matrix} ae - cd \\ e \end{matrix} \quad -\frac{(be - cf)\,(dh - ge)}{e\,(fh - ek)}\right]q_1 = \left[\frac{(ae - cd)\,(fh - ek) - (be - cf)\,(dh - ge)}{e\,(fh - ek)}\right]q_1 \quad (105)$$

But

$$q_1 + q_2 = \left(1 - \frac{dh - ge}{fh - ek}\right)q_1 = \left[\frac{h\,(f - d) + e\,(g - k)}{fh - ek}\right]q_1 \quad (106)$$

Whence,

$$V_{13} = \left[\frac{(ae - cd)\,(fh - ek) - (be - cf)\,(dh - ge)}{eh\,(f - d) + e^2\,(g - k)}\right](q_1 + q_2) \quad (107)$$

And finally the general expression for the coefficient of capacity, neglecting the effect of the images and observing that $(g - k) = e$, is

$$C''_{1234} = \frac{eh\,(f - d) + e^3}{(ae - cd)\,(fh - ek) - (be - cf)\,(dh - ge)} \quad (108)$$

In the special case where the wires are all of one size and the circuits are symmetrically grouped, or

$$\left.\begin{aligned} d_{12} &= d_{34} \\ d_{13} &= d_{24} \\ r_1 = r_2 &= r_3 = r_4 = r \end{aligned}\right\} \quad (109)$$

the charges are also symmetrically disposed, so that

$$\left.\begin{aligned} q_1 &= -q_4 \\ q_2 &= -q_3 \end{aligned}\right\} \quad (110)$$

In that case there are several new relations, as follows:

$$\left.\begin{aligned} f &= c \\ g &= d \\ (f - d) &= -h \\ (k - c) &= -(e - h) \\ k &= c - e + h \end{aligned}\right\} \quad (111)$$

Under these conditions,

$$C''''_{1234} = \frac{e + h}{a\,(e - c) + d\,(b - c)} \quad (112)$$

which expressed in complete terms is,

$$C'''_{1234} = \frac{\left(2\log\dfrac{d^2_{12}d_{14}d_{23}}{r^2 d^3_{13}}\right)}{\left(2\log\dfrac{d_{13}d_{14}}{r d_{12}}\right)\left(2\log\dfrac{d_{12}d_{23}}{r d_{13}}\right) + \left(2\log\dfrac{d_{12}d_{14}}{r d_{13}}\right)\left(2\log\dfrac{d_{13}d_{23}}{r d_{12}}\right)} \quad (113)$$

Expression (113) gives the total capacity of a four-wire circuit under the conditions expressed in (109). The effect of the images can be included if the complete form of the potential coefficients is retained from the outset, but it merely complicates the solution without giving any practical results in most cases.

The problem can be solved in another way if desired, but the method given is the least complicated and is the most direct one. If the equations in (93) are converted to the form

$$\left.\begin{aligned} q_1 &= C_{11}V_1 + C_{12}V_2 + C_{13}V_3 + C_{14}V_4 \\ q_2 &= C_{12}V_1 + C_{22}V_2 + C_{23}V_3 + C_{24}V_4 \\ q_3 &= C_{13}V_1 + C_{23}V_2 + C_{33}V_3 + C_{34}V_4 \\ q_4 &= C_{14}V_1 + C_{24}V_2 + C_{34}V_3 + C_{44}V_4 \end{aligned}\right\} \quad (114)$$

where the capacity coefficients have the same form as in the case of four grounded wires it can then be shown that

$$C''_{1234} = \frac{(C_{11} + 2C_{12} + C_{22})\,(C_{33} + 2C_{34} + C_{44})}{(C_{11} + 2C_{13} + C_{33}) + 2\,(C_{13} + C_{14})} - \frac{(C_{13} + C_{14} + C_{23} + C_{24})^2}{+ (C_{23} + C_{24}) + (C_{33} + 2C_{34} + C_{44})} \quad (115)$$

This expression is entirely general and includes the effect of the images. In the case of four equal wires symmetrically disposed, under the conditions given in (109), there are certain new relations between the capacity coefficients

in (115), as follows:

$$\left.\begin{aligned} C_{11} &= C_{44} \\ C_{22} &= C_{33} \\ C_{12} &= C_{34} \\ C_{13} &= C_{24} \end{aligned}\right\} \qquad (116)$$

from which it is evident that

$$C'''_{1234} = \tfrac{1}{2}\,(C_{11} + C_{22} + 2\,C_{13} - 2\,C_{12} - C_{14} - C_{23}) \qquad (117)$$

One of the cases of practical interest arises when two adjacent metallic pairs are employed to secure a phantom telephone circuit. In most cases of this kind the wire separations are those indicated in Fig. 12, and the conductors are alike in size and composition. Symmetry of the pairs as to size and grouping is very essential in securing a balanced phantom circuit.

Wires *1* and *2* form one metallic pair and one side of the phantom circuit, while *3* and *4* form the other. Assuming the wires to be No. 12 N. B. S. G., or 0.104 in. in diameter, the phantom capacity is

$$C'''_{1234} = 0.01350 \text{ mfd per mile.} \qquad (118)$$

In order to show that this capacity is not the sum of C_{14} and C_{23}, calculated in each case as though the other pair

Fig. 12—Four Wires; One Metallic Circuit.

were absent, using (73), the latter expression has been applied in the manner just indicated with the results,

$$\left.\begin{aligned} C'''_{14} &= 0.006838 \\ C'''_{23} &= 0.008218 \end{aligned}\right\} \qquad (119)$$

$$0.015056$$

The sum of these capacities exceeds the true capacity of the phantom by about 12 per cent of the latter. The capacity of the phantom is greater than the capacity of pair *1-2* or *3-4*, taken alone, by about 64 per cent, while the conductance of the phantom is 200 per cent of the conductance of either pair. That is, a phantom circuit compared with one of its component physical circuits in this case has 200 per cent conductance and 164 per cent capacity, relatively, which shows that the attenuation will be less on the phantom than on either physical circuit.

The equivalent single pair of equal conductance and capacity for this case would have conductors of a diameter of 0.1471 in., separated 2.02 in. between centers. This value of separation is computed from (73), which does not apply when $\frac{d}{r}$ is small. The error in this case is not large, since $\frac{d}{r} = 13.7$ approximately. In general, when single conductors are replaced by multiple conductors in parallel, with some separation between the members, the total capacity is much increased and at the same time the electrostatic stresses are limited to lower values. This suggests a method of avoiding the corona effect with small wires by means of what is the equivalent of open stranding. The corona will appear again, of course, at some higher critical voltage when the stress limits of the dielectric are reached.

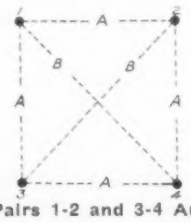


Fig. 13—Four Wires; Pairs 1-2 and 3-4 Arranged for a Phantom Circuit with Neutral Balance.

Returning to the consideration of a phantom like that in Fig. 12, it is evident that while the four charges are symmetrically disposed they are not all equal. That is, the charge on wire *1* is less than the charge on *2*. When the charges on *1* and *2* are unequal it is quite evident that interference will result between the phantom and the physical pairs, for, while the impressed emfs on *1* and *2* are equal, the charging currents will be unequal and a difference of potential will arise, being cumulative with increasing distances from the impressed source. Therefore, it is apparent that the physical pairs must be transposed against each other to prevent interference of a conductive nature caused by unbalance, otherwise the phantom cannot be secured. Transposition of each pair is necessary to secure a full balance. The result will not affect the capacities, but will equalize the charging currents, or the charging components of the total current.

In order that transposition shall be unnecessary the charges on each pair must be equal; that is,

$$\left.\begin{aligned} q_1 &= q_2 \\ q_3 &= q_4 \end{aligned}\right\} \qquad (120)$$

This condition imposed on the general case results in the expression

$$e\,(k+g) = h\,(f+d) \qquad (121)$$

When the four conductors are alike in diameter the condition imposed by (121) requires in turn that

$$\left.\begin{aligned} d_{12} &= d_{34} \\ d_{13} &= d_{24} \\ d_{14} &= d_{23} \end{aligned}\right\} \qquad (122)$$

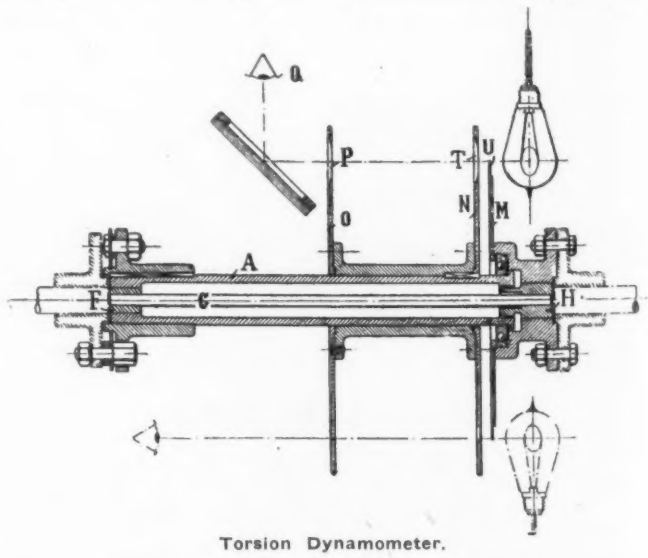
which can only be satisfied by a disposition of the four conductors at the corners of a square, as shown in Fig. 13. The same conclusions will be reached from a consideration of the inductances, self and mutual, and the inductive drop in each conductor.

The conclusion of the article will follow in a later issue.

TORSION DYNAMOMETER.

A form of torsion dynamometer designed for measuring the mechanical power transmitted to or from high-speed machines, such as centrifugal pumps, fans, turbo-compressors, steam turbines, generators, etc., where the torque values are fairly constant was described by Dr. Alfred Amsler, of Schaffhausen, Germany, at the Zurich meeting of the British Institution of Mechanical Engineers during the present month.

The dynamometer, as shown in section in the illustration, operates on the principle of a torsion spring, the angle through which the opposite ends are turned being proportional to the twisting moment and so to the power transmitted. The shaft is made of a special spring steel of very high yield-point (90,000 lb. per square inch) and it can be twisted to a considerable degree without breakage or permanent distortion. For example, in the illustration the twist of



Torsion Dynamometer.

the rod 15¾ in. long is about 20 deg. for a twisting moment of 1736 in.-lb. The shaft has a cross-section of 0.4725 in. by 0.4725 in. and is therefore subjected to a stress of 78,000 lb. per square inch, which is well below the yield-point. The various parts attached to the shaft *G* serve partly for indicating its angle of twist and partly to prevent it from being twisted excessively, so that it cannot be overloaded.

For reading the angle of twist three disks *M*, *N* and *O* are used. *M* is fixed firmly to the end *H* of the shaft, *N* and *O* are fixed firmly to the end *F* of the shaft. The disk *O* is provided with a radial slit *P*. To the disk *M* a transparent rim *U* made of celluloid is fixed, on which the divisions are cut. Opposite to the slit *P* a small window has been cut out in the disk *N* and is provided with a fine slit *T*.

When the eye *Q* looks through the slit *P* the slit *T* will be seen as a streak of light and the divisions will show black on the scale *U*. The slit *T* serves as a pointer for indicating the relative motion of the two disks *N* and *O* as compared to the disk *M*. The line of vision is perfectly defined by the two slits *P* and *T*; parallax is therefore impossible when reading the scale and the observation is independent of the distance between the scale *U* and the slit *T*.

When the apparatus is stationary it will be clear that, if the shaft is twisted, the angle of twist will be shown by the movement of the pointer *T* over the division *U*. This pointer and division are also visible when the instrument is running, in fact clearer and more defined than when the instrument is at rest. The greater the distance from the slit *P* the more the scale will appear to be enlarged; this enlargement is independent of the speed. At velocities below 250 r.p.m. the reading of the machine becomes cumbersome but still possible. The screen is intensely illuminated by a 50-cp incandescent lamp. These instruments are made generally for high speeds of about 4500 r.p.m., but some instruments have already been made for speeds of 7000 r.p.m. and even 8500 r.p.m. The coefficient of elasticity of the shaft can be determined when at rest by fixing a lever of known length at one end and loading this with weights. The largest instrument at present made can measure torques up to 130,200 in.-lb. and the smallest up to 694 in.-lb. The instrument suffers from one defect, the air-resistance of the rotating parts. This, however, is very small, especially when the dynamometer is so inserted that the disk *M* is placed nearest to the machine the power of which is to be measured.

Central Station
Management, Policies and Commercial Methods

ELECTRIC IRONS ON THE RANCH.

Electric flatirons are being extensively used by the wives and daughters of ranchmen located in the agricultural sections of northern Colorado. Energy is supplied throughout the district between Lafayette and Greely by the Northern Colorado Power Company, which has a large and increasing motor and lighting load in the ranch country. Out-of-door ironing is very popular.

SANDUSKY'S NEW CENTRAL-STATION SIGN.

The Sandusky (Ohio) Gas & Electric Company is inaugurating an electric-sign campaign among the business houses of the city by the installation of a novel spectacular display on its own roof advertising central-station service. The sign will show the name of the company together with the figure of a little girl, "Miss Sandusky," who appears to operate first one switch, turning on an electric lamp, and then a second one, starting in motion an electric motor driving belts, pulleys, etc. The purpose of this display, according to Mr. E. A. Bechstein, manager of the company, to whom the idea of the sign is due, is to illustrate how easily electric service can be controlled by a mere child. The display will measure about 30 ft. square and will require 800 tungsten and carbon-filament lamps.

TELAUTOGRAPH IN APPARATUS SHOWROOM.

A pair of telautograph instruments has been installed between the display-room of the Union Electric Light & Power Company, St. Louis, and its main salesroom, enabling the attendant in charge to communicate with headquarters, ask for information, relief, etc., without leaving her station. The telautograph has thus proved practically useful as a means of communication and attracts a great deal of interest from visitors to the central-station's display-room, who marvel at its truthful reproduction of their handwriting.

Several telautograph sets have found valuable uses in St. Louis in the offices of bank presidents and men of affairs. The apparatus is installed in an upper desk drawer, and if during an interview with a business caller the banker desires special information, he can, all unnoticed by his visitor, open the drawer, write his query and receive a confidential answer from his clerk outside.

ELECTRIC SERVICE EXHIBIT AT CANADIAN INDUSTRIAL EXPOSITION.

The exhibit of the Winnipeg City Light & Power Department at the recent Canadian Industrial Exhibition held in Winnipeg, was given the form of a model bungalow or dwelling completely equipped with electrical conveniences in all of its four rooms, boudoir, living-room, dining-room and kitchen.

The living-room, tastefully but not extravagantly furnished, was a model of comfort with its electric grate, reading lamp and the ornamental electric fixtures. An electric piano rendered selections from the great masters with almost perfect touch and skill. An electric cigar-lighter and corn popper occupied places on the table, while from the mantel the breeze of an electric fan kept the room comfortable. The lady's boudoir adjoining contained an electric hair drier, vibrator, curling tongs, water heater, desk lamp, etc. The dining-room and kitchen equipment included examples of every variety of cooking appliance that could add to the convenience of housekeeping.

A daily bulletin published in the interests of the new civic power development and covering various happenings and features of the exhibit was presented to each visitor entering the exhibit. On Tuesday, July 18, Citizens' Day, more than 10,000 people filed past the display.

To illustrate the contrast in living conditions brought about by electrical conveniences an "old-way" house was arranged adjoining the electric-service exhibit. This ramshackle, delapidated hut, which proved one of the sensations of the exhibit, was occupied by a "crazy woman," impersonated by a local comedian, whose antics entertained the crowds.

Adjoining the exhibit hall, in the Manufacturers' Build-

ing, was a working model of the new 35,000-hp plant at Point du Bois, on the Winnipeg River. This was an exact reproduction of the power-development dam and showed the power house as it will look when finished several months hence. The model was complete in every detail from the woods that line the river bank to the first few steel towers of the double transmission line which runs 77 miles across the country to Winnipeg.

At the close of the ten-day exhibition an electrically cooked banquet, laid for eighteen plates, was tendered the Mayor and Council of Winnipeg, as mentioned in the *Electrical World* of Aug. 5. Mr. James G. Rossman, general manager of the department, presided at the dinner, the elaborate electrical preparation of which was supervised by Mrs. Rossman, whose taste was also displayed in the furnishings and arrangement of the "Home, Sweet Home" exhibit.

A GAS-ENGINE WARNING.

Between embossed covers of lurid colors a warning booklet on the subject of gas-engine costs, dangers and annoyances has been published by the Cleveland Electric Illuminating Company for local distribution. The booklet points out that in computing operating costs gas-engine users often overlook the many serious items of expense beside fuel, although in the case of an electric motor practically the only expense is for electrical energy. The costs of oil, water, repairs, labor, depreciation, interest, taxes, insurance, rental value of space occupied, etc., are all enumerated in the case against the gas engine. The repairs on a small gas engine amount annually to from 8 per cent to 15 per cent of the engine's first cost. A capable attendant must be employed to supervise the sensitive mechanism of the engine. Depreciation of the latter's value will range from 10 per cent to 35 per cent, for some engines must be scrapped after three years' service. Gas engines take up valuable space and require good foundations, in contrast to motors, which can be suspended from the ceiling if desired. To withstand overloads gas engines must be purchased of excess ratings and consequently operate with low efficiency at normal partial-load conditions. Although gas-engine salesmen often promise consumptions of only 15 cu. ft. per kw-hour on natural gas, actual tests have shown the consumption to be more nearly from 30 cu. ft. to 40 cu. ft. With artificial gas the consumption will average from 53 cu. ft. to 75 cu. ft. per kw-hour delivered. Gas engines are inherently noisy, and in Cleveland recently a gas-engine owner was sued by his neighbors on account of the annoyance of the exhaust. The arguments conclude with the point that, while an isolated plant precludes enlargement, with central-station service motors can be added at only proportional expense as the business increases.

OFF-PEAK SERVICE FOR BAKER'S ELECTRIC OVENS IN MILWAUKEE.

One of the first electric bread ovens to be installed in a commercial bakery in the United States has just been placed in service in a Milwaukee bakery, using electrical energy from the central-station lines during the off-peak period. This oven has a daily capacity of 1000 loaves and is rated at 10 kw. For this off-peak service the baker pays an average of 4 cents per kw-hour, making the cost of operating the oven about $100 per month. Under his contract the baker is limited to the use of the oven during ten night and early-morning hours after the heavy lighting demand on the station has passed, but the oven consumption is connected under the same meter with the rest of the installation, and except for the terms of the contract there is no clock device to prevent the use of energy at any hour.

This first bakery to install an electric oven in Milwaukee is one of the largest plants in the city, having a daily capacity of 24,000 loaves, so that the successful operation of the new oven will open the way for a number of other ovens in this bakery alone. Following the installation of the oven the bakery company plans to advertise in the newspapers, inviting the public to visit and inspect the electric oven. The latter has been specially constructed with a white-marble-panel switchboard, glass doors and nickel trimmings, the oven doors permitting a full view of the baking operation inside. According to Mr. M. F. Flynn, of the Milwaukee Electric Railway & Light Company, who solicited this commercial use of electric cooking, the work of the contract department has not ceased with the oven, as efforts are now being made to have the electrically baked bread delivered to grocers by electric vehicles.

SIGN AND OUTLINE LIGHTING WITH TUNGSTEN LAMPS.

A warning against the use of small tungsten sign lamps in series, unless purchased especially for such connection, was sounded in the discussion following a paper by Mr. W. B. Goudey, of East Liverpool, Ohio, on the subject of sign lighting, read before the Ohio Electric Light Association at its Cedar Point convention July 28.

Two years ago the East Liverpool company began a sign campaign, building its own signs for 5-watt tungsten lamps. To eliminate the cost of transformers, series-connected sockets were installed. "The first five months," said Mr. Goudey, "we built signs with a total capacity of over 2000 lamps. During that five months we had trouble thick and fast. Our signs were almost always in distress, in spite of our best efforts. I remember having renewed over sixty lamps in less than three months in a sign of 120 lamps. It was almost amusing to travel over the sign circuit and note the different combinations of letters caused by certain circuits having burned out. A halt was called about this time on series-burning signs and those already in service were taken down as fast as possible and reconstructed with multiple wiring at the expense of the company. We have now about 5000 sign lamps on our circuits in East Liverpool, all arranged for multiple burning in connection with sign transformers, and our renewals per month average less than 1 per cent. It was learned later that a great part of the above trouble was caused by using lamps selected for multiple instead of series wiring. However, it is possible to get fairly satisfactory results from series-connected sign lamps, provided proper care is taken to obtain lamps selected for series operation. This should be especially mentioned when ordering from manufacturers."

For direct-current work series multiple wiring is the better method, said the author. The lamps are wired in multiple and then the multiple groups are connected in series. If one lamp burns out the remaining seven lamps operate at a slightly higher efficiency and their life will be somewhat shortened. But when a large number of lamps are used the failure of any lamp will not affect the others to any great extent. Series multiple wiring should not be employed on signs having less than eighty lamps, and for best results the signs should have 100 lamps or more. Signs operated on direct current and using carbon lamps can be readily changed to take care of tungsten lamps at little cost for rewiring by cutting open the conductor on alternate sides of the groups of lamps and converting them to series-multiple connection.

Mr. G. H. Stickney, of Schenectady, N. Y., urged that

central stations open the way for sign business by showing their own faith in this mode of advertising and installing displays. Mr. W. A. Benedict spoke of the advantageous use of 2½-watt sign lamps where freedom from glare and less brilliancy are required. Mr. C. I. Crippen referred to the superiority of the 2½-watt, 2-cp tungsten lamp over the old 2-cp carbon lamp. Mr. J. T. Kermode declared that as the result of his own experience in attempting to maintain series-connected sign circuits he would advise the use of even carbon lamps in direct-current signs where no low-voltage source is available for multiple operation of the lamps. Tests on several series-connected tungsten signs, reported by Mr. O. B. Reemelin, of Dayton, showed pressures varying from 9½ volts to 13½ volts when ordinary multiple lamps were used, although the drop was uniformly about 11½ volts in the case of the specially selected series lamps.

THE ENFORCEMENT OF OFF-PEAK POWER CONTRACTS.

A few years ago the number of electric-service companies selling electricity for motors under off-peak contracts which give a low rate in consideration of motors not being operated during winter peak-load periods could be counted on the fingers of one hand. The advantages of such off-peak load have been so apparent, however, that there are now scores of companies making off-peak rates to special motor customers. The principal argument urged against this practice has always been the difficulty of preventing customers from operating motors during the prohibited hours. Some companies allow motors to be operated during the hours prohibited in the contract except at times when the reserve capacity of the station is needed for carrying the lighting load. In other words, as long as the company has reserve station capacity which can be used during peak-load hours to operate these motors, the company allows them to operate; but in case one unit is out of service, thus reducing the capacity of the station, the attention of consumers is called to the off-peak contract and they are requested to shut down during the prohibited hours.

It sometimes happens that, although the consumer who signs the contract may understand the off-peak clause, the men who actually operate the motors do not. A central station in northern Michigan last winter had a rather uncomfortable experience along this line. An installation of several motors was taken on an off-peak contract and last December the owner of the establishment was notified that he must not operate his motors during the peak-load hours. In spite of this the motors were used one evening about the time of the yearly peak with rather disastrous results to the service. The motors were started by employees who were not familiar with the terms of the contract or with the disastrous effect the operation of these motors would have on the ability of the central station to maintain voltage on the system. As a result of this another manager, hearing of this experience, has had issued a notice, to be posted over each motor which is being served under an off-peak contract, which may serve as a useful hint to others. A copy of this notice follows:

"The rate charged for the electricity supplying this motor is less than charged ordinary motor users under unlimited power contract for the reason that it is agreed and understood that the user of this motor will not operate it between 4:30 p. m. and 8 p. m. any day between Oct. 15 and Feb. 15 whenever the company supplying the electricity requests. Operating this motor during the hours specified without permission of the supply company will cause a discontinuance of the low 'limited off-peak contract' rate for electricity under which this motor is now supplied and thereafter the full unlimited power rate will be charged."

HANDLING CUSTOMERS' ORDERS.

In a discussion on the subject of handling customers' orders before the accounting session at the last convention of the National Electric Light Association in New York, Mr. R. S. Hale, of the Edison Electric Illuminating Company of Boston, referred to a form used to explain possible delays in the connection of service. This form is given to a customer at the time an application is signed. It consists of a postal card, with an explanatory statement attached which can be torn off if the postal card is used.

Customers are requested to send the postal card to the company if service is not provided and an immediate investigation will be made. It is explained that in many cases the company is not allowed to furnish electricity until a permit has been received from the city authorities. Application for such a permit is made when the application is taken from a customer, but the municipal inspector does not examine the work until he receives notice from the wiring contractor or from the owner that the installation is ready for inspection. It is also explained that if there is delay in securing the permit from the city the company can do nothing and the customer or wiring contractor should take any steps that are necessary to hasten the matter.

Application may have been made in some locality where the company has no service and has to build new lines, which involves an unusual delay. In the suburban district distances are so great, the company adds, that trips are made only at intervals, usually about a week apart. "Please appreciate," the card says, "that our income does not start until the current is turned on, and it is therefore to our interest to serve you as promptly as we can." The postal card is addressed to the information department of the company, and provides for a statement of the time the application was signed by the customer, and the location at which service was to be supplied, together with a request for the cause of delay.

The timetable on the postal card gives three typical cases, A. B and C. In case A, in which the service meter and lamps are in and there is nothing for the company to do but provide the electricity, the minimum time required is stated to be one-half day, and the average time two days. The customer is requested to inquire after three days, unless the delay is due to some of the possible reasons for delay mentioned in the foregoing. In case B the wiring and service are completed and the meter and lamps are wanted. The minimum time required for this work is one day, and the average time four days. Unless delay is due to other possible reasons the customer is requested to inquire after seven days. In case C the service is not in, so that new lines, poles or digging is required. The minimum time for this work is three days, and the average time ten days. Inquiry should be made after fourteen days, unless the delay is due to some of the other causes mentioned.

The minimum times stated refer only to the ordinary routine; in case of emergency a service is put in by the company in much less time, but for obvious reasons this fact is not advertised to the ordinary customer.

USES FOR MERCURY-ARC RECTIFIERS.

Applications where the mercury-arc rectifier can be used to advantage were pointed out by Mr. J. T. Kermode, of the Cleveland Electric Illuminating Company ,in a paper read before the Ohio Electric Light Association July 27. For charging the batteries of electric vehicles mercury-arc rectifiers are preferable to any other kind of converting apparatus owing to their ease and simplicity of operation. Equivalent motor-generator sets require an increase in the line, service, transformer and meter investment and often cause annoying line fluctuations. In private garages in

Cleveland there are now 453 mercury-arc rectifiers and 180 motor-generator sets. For large public garages, however, motor-generators sets may be more economical.

Where rectified alternating current is used for street lighting line surges are likely to result, especially on underground circuits, so that the lines should be insulated for at least twice their normal potential. Lead-sheathed cable which has withstood a potential of 6000 volts direct current for years has been known to break down when subjected to a strain of 4500 volts rectified current.

The light thrown on a screen from a projection lantern operated by direct current is clearer than that from an alternating-current arc. The mercury-arc rectifier can, therefore, be used to distinct advantage in operating moving-picture machines. Not only is a clearer picture obtained, but the energy consumption is reduced, as the direct-current lamp requires less energy for a given lighting effect than the alternating-current arc. For example, a certain moving-picture show in Cleveland operating an alternating-current arc used an average of 826 kw-hours per week, including all the lighting in the theater. Later this lamp was replaced by a direct-current arc, operated through a mercury-arc rectifier, and the average weekly consumption dropped off 108 kw-hours, which shows a decrease of 13 per cent for the whole installation, or nearly 50 per cent for the arc alone.

In discussing mercury-arc applications Mr. G. H. Stickney, of Schenectady, N. Y., said that for projection-lantern work the alternating-current arc is liable to fluttering, while the direct-current arc is punished by the insertion of resistance. Mr. Stickney referred to comparative investigations of projector operation by Mr. Gage, recently reprinted in the *Electrical World*.

Among new uses found for rectifier sets Mr. R. E. Russell, also of Schenectady, N. Y., mentioned charging service for telegraph batteries, operation of direct-current signals on steam railroads, charging batteries for oil-switch operation, operation of photo-engraving lamps, supply for electrolytic baths, producing bleaching chlorine for laundries, operation of X-ray coils, etc. In answer to a question, Mr. W. S. Culver, of Schenectady, said that the cost of arc-lamp cables might be slightly higher when for use with rectified current than where motor-generator sets are employed.

Wiring and Illumination

TUNGSTEN CLUSTERS ON CHICAGO'S LAKE-FRONT BOULEVARD.

As an example of civic lighting the new tungsten-cluster illumination of Michigan Boulevard, Chicago, between Twelfth and Randolph Streets, will probably long remain unequaled on any other street or avenue in the country. Few other thoroughfares have such advantages of setting as huge blocks of buildings on one side, fronting opposite 1¼ miles of unbroken parkway bordering a matchless waterfront like that of Lake Michigan, and the final touch has been added to this scene, both by night and by day, through the installation of the first 100 or more graceful six-lamp standards bordering the park curb.

These cast-iron pillars, as outlined in the *Electrical World* of Dec. 22, 1910, are 19 ft. 6 in. in height and are surmounted by a Renaissance cap with six richly ornamented arms from each of which are suspended 100-watt tungsten lamps in 12-in. Alba globes at a height of 15 ft. above the street level. The posts are installed at intervals of about 80 ft. along the curb line, the illuminated length of sidewalk being nearly 1¼ miles from Randolph Street to Park Row. The row of pillars on the park side of the street has just been completed and similar posts are now being placed opposite the present ones on the west side of the boulevard. Altogether 135 of these posts will be required for the completed illumination. The present tungsten-cluster installation was selected by a committee of judges after a series of practical tests lasting more than a year, during the course of which installations of open and inclosed carbon-arc lamps, metallic-flame lamps, white and

Tungsten Cluster Lighting in Chicago.

orange flaming-arc lamps, tungsten clusters and mantle gas lamps were put up along sections of Michigan Avenue.

The new curb-lighting posts were designed by D. H. Burnham & Company, architects, Chicago. The installation is being made by the Board of South Park Commissioners, which obtains electrical energy for lighting from the Sanitary District of Chicago.

MONOCHROMATIC LIGHT AND VISUAL ACUITY.

By M. Luckiesh.

Owing to the fact that the human eye is not corrected for chromatic aberration, monochromatic light should produce a sharper retinal image than light sources commonly used for illuminants, nearly all of which radiate energy throughout the visible spectrum.

Dr. Louis Bell in the *Electrical World* of May 11, 1911, gives some interesting results of an investigation of the relative illuminations of mercury-tube light and tungsten light required to produce equal definition of the characters on an acuity chart. He attributes the superiority of mercury-tube light to its monochromatic character. This light approaches in spectral character more nearly to monochromatism than the light from a tungsten incandescent lamp, but it is far from monochromatic. Its luminosity is due to four lines in each of the following regions of the spectrum: Violet, blue, green and yellow. A great part of the total luminosity is due to the two lines yellow and green.

One objection to Dr. Bell's results is the fact that he assumed the mercury-tube light to be monochromatic and that he used no strictly monochromatic source. A second objection, and a serious one in the minds of many, is that in Dr. Bell's experiments is involved the question of the brightness of lights of different color. Dr. Bell assumes the correctness of the flicker photometer and explains the conflict of his results and those of Broca and Laporte on the ground that their brightness measurements were made with an equality-of-brightness photometer. That is, he implies that the flicker and equality-of-brightness methods would disagree. The investigations of Dr. Ives indicate a close agreement of the two methods at working illuminations, so that Dr. Bell's explanation cannot be considered entirely satisfactory. It would obviously be more satisfactory if the question at issue—the superior defining power of monochromatic light—could be settled without introducing the question of methods of heterochromatic photometry. This can be done, as is shown below.

By the use of absorbing solutions and glasses lights of the same hue but of different spectral character may be produced. For instance, the green mercury line can be

isolated, and thus a purely monochromatic illumination is at once available. This green line can be matched in hue by a screen transmitting tungsten light of correct proportions from 0.500μ to 0.600μ. These two screens over their respective sources produce a match in hue so slightly differing in degree of saturation that the resultant lights can be compared very accurately by the usual methods without involving any of the difficulties such as would obtain in a comparison of the mercury-tube light with the light from a tungsten lamp. An example of the accuracy of the luminosity balance obtained in a particular case will be given later. Other absorbing media were prepared which gave similar matches of hue of varying degrees of monochromatism. The transmission of each of the screens is shown in Fig. 1. It must be remembered that luminosity and photochemical action have no direct relation; the photographs merely show the extent of the transmission bands. Screen *A* consisted of potassium bichromate and neodymium ammonium nitrate dissolved in water. This screen served two purposes. It transmitted only the green mercury line (0.546μ) and it also matched the sodium yellow line by transmitted tungsten light. From a continuous-spectrum source it transmitted two bands—one maximum being in the green and the other in the red part of the visible spectrum. Screen *B* was an aqueous solution of potassium bichromate of such density that it matched (by transmitted tungsten light) the hue of the sodium yellow line (0.5893μ). Screen *C* consisted of three glasses which by transmitted tungsten light matched in hue the green mercury line. When *A* and *B* transmitted tungsten light they were of the same yellow hue.

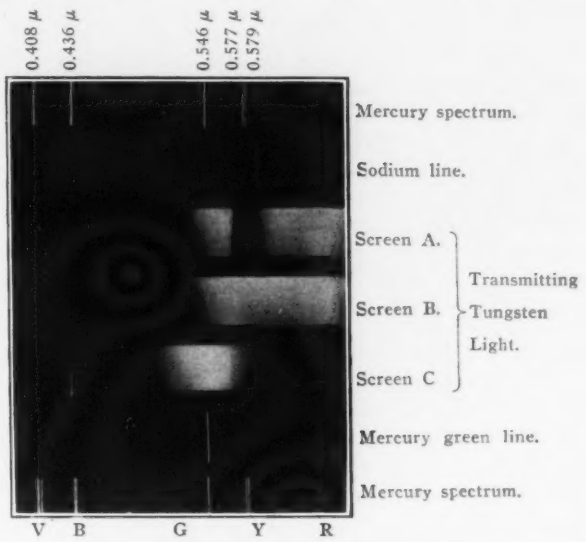


Fig. 1—Transmission Bands of Various Screens.

Various acuity photometers were devised, one being a Bunsen photometer with the grease-spot field replaced by a white opaque slide with similar black characters on both sides. The instrument used in the first part of the work was a very common form shown in Fig. 2. L_1 L_2 are the light sources, *c* is an opaque black partition, *b b* are mirrors, and *d d* are plane glass cells containing the various solutions or the colored glasses. A double-column page of printed matter was placed at *a a* and viewed with both eyes. Approximately the same results were obtained with the left eye alone. By viewing both sides of the photometer field simultaneously the question of pupillary contraction (considered by Ashe as accounting for some of the results of Bell) is practically eliminated. Dr. Bell, however, has shown this to be of minor importance by the use of an artificial pupil. Both eyes were used in order to approach practical conditions. The chart was viewed from a distance of approximately 1 m.

The method of procedure was as follows: The screens were placed in position and then with both sides of the photometer field of the same hue the relative intensities of the two sources were obtained. With no difference in hue present, a luminosity balance was easily obtained by either the flicker or equality-of-brightness method, both giving the same results. The illumination was kept as high as possible. After a luminosity balance was obtained the acuity photometer was then placed at the same position at which the equality-of-brightness photometer was stationed. The illumination on one side was kept constant while that of the other side was varied until both sides of the acuity chart appeared equally distinct. Then the ratio of illumination on the two sides was obtained by means of the inverse-square law. This ratio is shown in the last column of the accompanying table. In cases I, II, III a double-column page of type was used as an acuity chart and results given are the mean of many observations made by the writer. In every case the more nearly monochromatic source required less illumination for the same distinctness of detail. The photometers were reversed to eliminate any instrumental errors, and in case II, where two tungsten lamps were used, it was possible to reverse the absorbing screens, thus eliminating any prejudice. A sodium flame was so devised that it burned quite steadily. This was used as a monochromatic source, it having only a double line in the visible spectrum at 0.5893μ. This monochromatic yellow was matched in hue by screen *A*, which transmitted light, as shown in Fig. 1. Several other experiments, which, however, were not free from hue difference, showed an advantage in favor of the more nearly monochromatic source. Case II is interesting inasmuch as neither screen was monochromatic. However, screen *A*, which transmitted two bands, and therefore two maxima, gave poorer definition. Several observers were asked to make settings in cases I, II, III, and there was no doubt in regard to the side of the acuity chart which was more clearly defined.

TABLE SHOWING RATIO OF ILLUMINATION.

Case.	Screen	Source.	Color of Transmitted Light.	Approximate Illumination (Ft.-Candles).	Advantage of More Nearly Monochromatic Illumination in Distinguishing Detail.
I.	A	Mercury tube	Green mercury line		
	C	Tungsten lamp	Green	2.0	1.75
II.	A	Tungsten lamp	Yellow	4.0	1.33
	B	Tungsten lamp	Yellow		
III.	None	Sodium line	Yellow		
	A	Tungsten lamp	Yellow	0.5	1.66
IV.	A	Mercury tube	Green mercury line	0.6	(P.W.C.) 4.90
	C	Tungsten lamp	Green		(M.L.) 5.10 (H.E.I.) 1.33

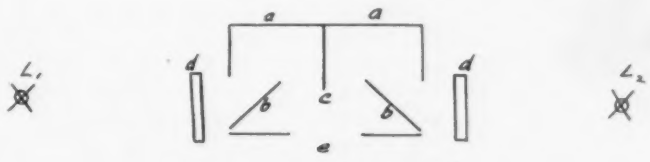


Fig. 2—Bunsen Photometer.

To check these results it was decided to use a better acuity object (which was in use for another investigation when the above experiments were being made) and to ask several experienced observers to make some settings. The chart at *a a*, Fig. 2, was removed and a white matt surface

was substituted. The visual-acuity object devised by Dr. Herbert E. Ives, and described in the *Electrical World* for April 14, 1910, was placed in front of the acuity photometer at *c*. This acuity object consists of two black-line gratings (240 lines per inch) placed face to face. By means of a graduated drum on a micrometer screw the relative angular positions of the gratings can be changed and secondary lines of any spacing or size may be obtained. For all spacing of the lines the total flux of light remains constant. The illumination at *a a* in this case was 3 ft.-candles, and the transmission of the acuity object being 0.2 the resultant brightness of the matt surface was equivalent to that produced by an illumination of 0.6 ft.-candle, which was lower than desired owing to the absorption of the acuity object, but with the apparatus as set up it was inconvenient to obtain a greater illumination. Without any hue difference this rather low illumination was not objectionable. Dr. Herbert E. Ives and Dr. P. W. Cobb kindly volunteered to make some observations, and the writer takes this opportunity to thank them for their helpful assistance.

The procedure was as follows: The side illuminated by green tungsten light was screened off and the object illuminated by the green mercury line. The drum of the acuity object was turned until the lines became so small that they just disappeared or vice versa. A mean of ten settings was obtained by each observer. Each observer then set the drum at the mean value which he obtained, and with green tungsten light (screen *c*) illuminating the object the illumination was varied until the lines just appeared or disappeared. A mean of ten settings of the tungsten lamp was then taken for each observer. Then, with the apparatus as set up, the drum of the acuity test plate turned until the lines were no longer visible, each observer made ten settings for equality of brightness. No difficulty was experienced in this because there was no hue difference in the photometer field. This latter point was further tested by a comparison of the results obtained by the three observers with a very sensitive equality-of-brightness photometer. There was only 1 per cent difference in the readings of the observers obtaining the highest and lowest values of the relative illumination of the two sides of the photometer field. Measurements with a flicker photometer showed the same agreement. This method affords a very accurate acuity test and some surprising results were obtained. These results are given in case IV in the table. Dr. Cobb and the writer required approximately *five* times as much illumination on the side of the photometer field illuminated by the tungsten light through screen *c* as was required on the side illuminated by the green mercury line. Dr. Ives required only one-third more light. The much greater illumination required by Dr. Cobb and the writer as compared with the much less illumination required by Dr. Ives is possibly explained in the following manner as suggested by Dr. Ives. All three observers wore glasses; Dr. Ives wore very strong concave lenses, while the two other observers wore weaker glasses either to correct for astigmatism or far sight. Now a *concave non-achromatic* glass lens in combination with the *convex non-achromatic* lens of the eye of lower dispersion than glass tends to form an achromatic combination. That is, the concave glasses would tend to move the focus for blue rays further back than it would move the focus for red rays, thus decreasing the natural chromatic aberration of the eye. Convex lenses would increase the distance between the points where the red and blue rays focus. The measurement of brightness by acuity is certainly beset with difficulties and uncertainties when three observers whose vision is corrected by the best skill of the optician differ in acuity measurement by several hundred per cent.

It was, of course, possible that pupillary contraction could account for the much greater definition obtained in the above experiment, as the two sides of the field were not viewed simultaneously and as no artificial pupil was used. This point was therefore investigated separately. The mirrors of the photometer were shifted so that the two sources illuminated the same spot on *a a*, Fig. 2. The two sides of the photometer were brought to a luminosity balance by inserting the opaque screen *c*. The screen was now removed and the sources were alternately screened off, so that the writer viewed first the field illuminated by the green mercury line and then by the tungsten light through screen *c*. The pupil was examined by another observer through a magnifying glass, and no movement whatever of the iris was detected, although the test was repeated several times with the details varied. This shows that pupillary contraction is not the explanation.

Another experiment was carried out which illustrates the obvious fact that brightness values obtained by the acuity method cannot be added. The acuity object mentioned above was illuminated from the rear side by a tungsten lamp through an opal glass. The object was viewed through a purple glass and a number of acuity readings were taken. A yellow glass was now combined with the purple glass, making a red combination, and the acuity actually increased. The yellow glass absorbed all the blue of the purple, thereby considerably decreasing the brightness, yet the acuity actually increased. Acuity also increased when the object was viewed through a signal green glass added to the purple glass. The signal green glass absorbed all the red of the purple, producing blue of lower brightness than the original purple. This amounts to saying that in some cases a red light added to a blue light will give less acuity than either light source alone. This fact is an obvious one, yet it shows that for many purposes for which light is used the acuity method would give misleading results and would offer an unfair comparison. A very small part of our "seeing" is done by observation of fine detail and much by observation of differences of light, shade and color.

While it seems to some that the acuity method is the only valid one, it must be remembered that in the case of general illumination the results obtained by this method would not give a correct measure of luminosity. In the case of general illumination the eye, as a rule, is concerned with the vision of comparatively large surfaces which present a low degree of brightness-difference between one another, and not with minimal-sized detail presenting the highest practical contrast as reading print. The fact that monochromatic light produces a more distinct retinal image does not argue that it is the better light for constant use in distinguishing fine detail. This advantage may be more than offset by a possible destruction of the ability to discriminate colors. A thorough study of physiological effect of monochromatic light may show it to be more disturbing to the other functions of the eye than lights which more nearly approach in spectral character the natural light under which the eye has evolved.

ELECTRIC WIRING AND ILLUMINATION OF LONDON AUTOMOBILE CLUB.

In the Royal Automobile Club, which was recently opened in London, particular attention was paid to the wiring and lighting installations in order that the results might be in harmony with the interior architectural effects. A view of the main hall, which is decorated throughout in the style of Louis XV, is given in Fig. 1. For the lighting of this hall use is made of both candelabra and brackets, the place of the candles being, of course, taken by electric candle lamps. The same idea is followed out in the other main rooms with excellent results. In the swimming bath, for instance, massive Greek bronze pendants of triangular

shape with a lamp at each corner are used, the effect being very striking, while standards, also of Greek pattern, are placed near the edge of the bath. For lighting the bath itself—that is, the water—metallic-filament lamps sunk in the cornice are used, the result of which arrangement can be seen in Fig. 3. The racquets courts, too, presented an interesting problem from the lighting point of view. It is, of course, necessary, in order that play be possible, that the ball shall cast no shadow. This condition was at last obtained after some trouble by using lamps suspended from the ceiling and placed in a reflecting trough inverted so that all the light is thrown downward. The most suitable height of these troughs was determined by experiment, and it was only after several heights had been tried that the one at last reached was chosen.

As regards the electrical equipment, great care has been taken to prevent all lamps being thrown out of service at one time. For this reason two separate sets of mains from the St. James & Pall Mall Electric Light Company's system enter the building at two separate places, each cable receiving energy from an entirely distinct source of supply. In one case the energy comes directly from Carnaby Street generating station and in the other through a substation from the generating station at St. John's Wood. The energy is delivered as direct current at 110 volts for lighting and 220 volts for motor service.

The supply mains come into a special chamber where switches and fuses are fitted, and thence pass to the intake chambers. One of these is provided for each of the two supply sources. They consist of a good-sized fireproof room (securely locked) and contain the double-pole switches and fuses controlling the sub-main circuits. These are fixed on marble boards fastened to iron framing to which are also fitted watt-hour meters for determining the energy consumption in various parts of the building. A view of one of these boards is shown in Fig. 4.

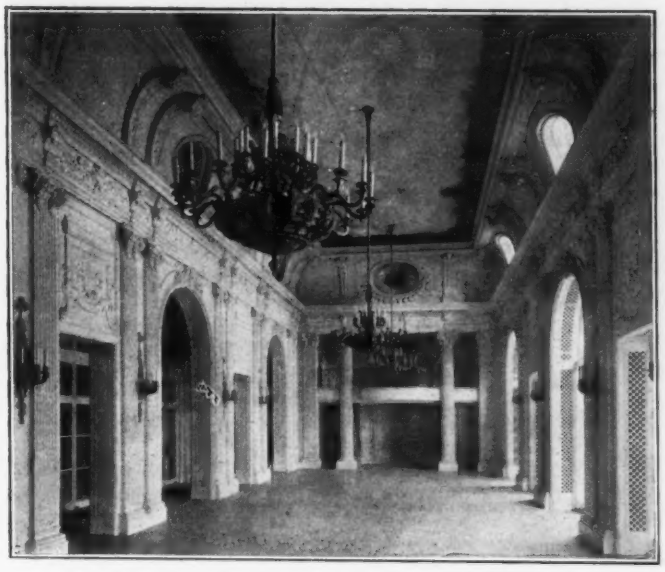


Fig 1—The Great Hall from the Platform.

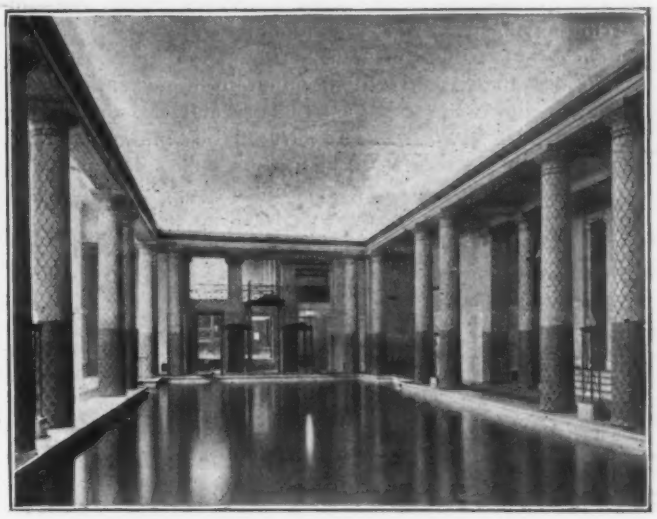


Fig. 3—The Swimming Bath.

The general arrangement of the supply is as follows: The building is divided approximately into two halves, each half having an entirely separate intake chamber. Each room is lighted from both mains so that should one of the supply company's mains break down the whole of the building would still be lighted. Moreover, all the corridors and halls are lighted from a special fire-alarm circuit, details of which are given below. The mains from the intake chamber to the main boards, and from the main boards to the sub-boards are paper-insulated, lead-covered and armored, and are run up special shafts along adjacent staircases. These shafts are easily available should it be

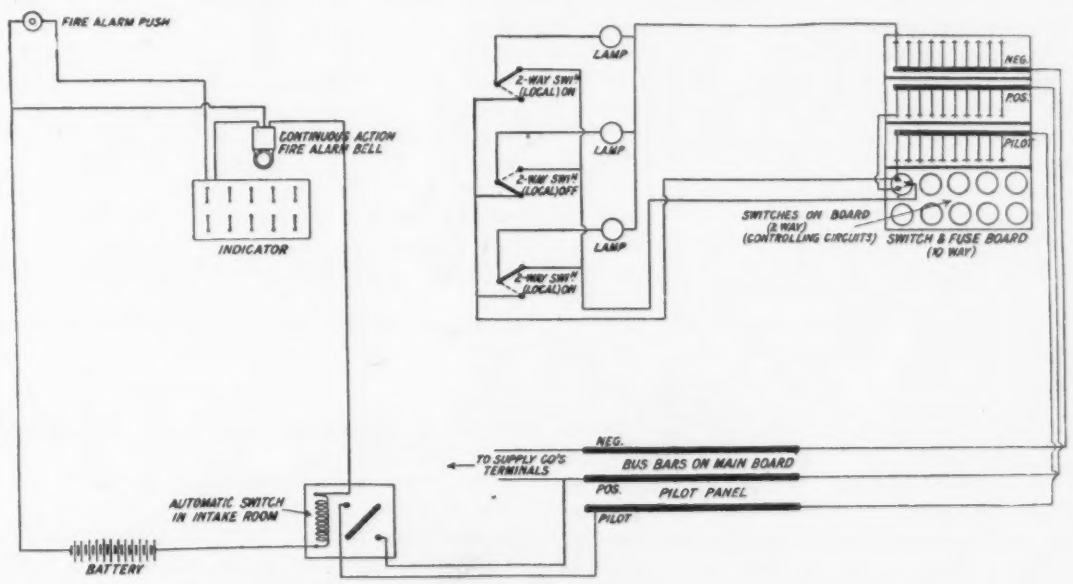


Fig. 2—Diagram Showing Connections of the Fire Alarm System.

necessary to inspect the cables. At each intake point arrangements are made for a three-wire lighting service and a two-wire motor service.

An ingenious method is employed for controlling the pilot lighting. The leads on one pole are split and pass in parallel through a two-way switch. One side of this switch controls the energy supplied to the various lamps through sub-distribution boards and special local switches in the ordinary way; the other side of the switch controls the energy supplied to the lamps directly through the sub-distribution boards and the other portion of the local switches. The pilot circuits on one side are also controlled by a single-pole switch, which, in its normal position, is held off by a catch. When the fire alarm is sounded by means of push buttons in any part of the building, the coil of the switch is energized and the catch is pulled off. The switch then falls by gravity and connects in circuit the pilot lamps throughout the staircases, corridors, etc., of the building. There are eight pilot circuits, controlled as explained above by a 50-amp triple-pole switch and fuses. The cut-in

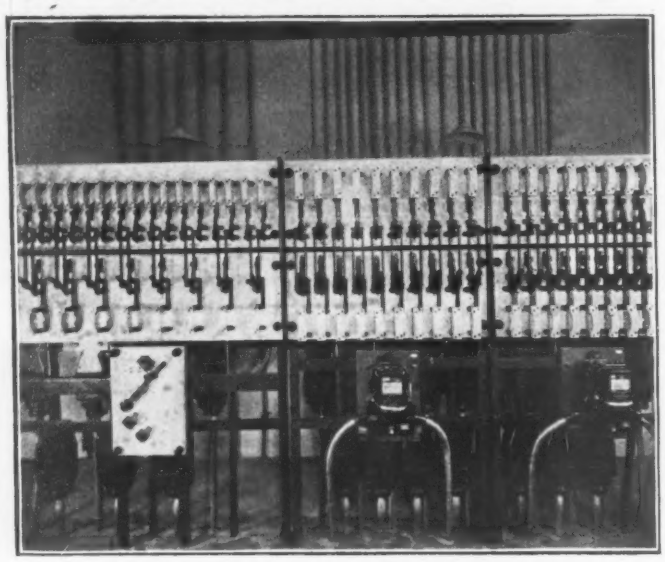


Fig. 4—View of One of the Main Switchboards.

switch arrangement is indicated diagrammatically in Fig. 3.

There are fifty-two general lighting circuits controlled from these boards, some of which receive energy from the Carnaby Street mains and some from the substation. All these circuits have a rating of 100 amp; twelve of them supply energy to the basement, which is metered separately and charged on a special rate. There are also twelve motor circuits receiving energy at 220 volts for working the elevators and fans, and two 110-volt circuits, one for supplying energy to the cinematograph in the lecture theater and the other to apparatus in the photograph-room.

From the sub-boards the wires are run in steel screwed conduit placed under the floors. Where the conduit enters the draw-in boxes it is fitted with brass bushings. The draw-in boxes are easily accessible through traps in the floor and are fitted with flush lids. All the conduit has been laid down to be electrically continuous throughout. The conduit is grounded at each intake room and distribution board by a cable connected to the nearest water pipe. It was tested for continuity by ringing an electric bell through it. All the conduit is of ample size for the wires it carries, and to insure that repairs could easily be made if necessary every wire was pushed into the conduit.

The distribution boards are contained in cast-iron cases lined with uralite and are sunk in the walls. The fuses are carried on marble panels, the two poles being carefully separated. Tubular fuses of 10-amp rating are used on all the lighting boards. Front connections are employed in every case, and great care has been taken to keep the conduits receiving energy from different sources of supply entirely separate. The two runs of conduit are placed quite apart under the floor, while no switch or fitting on one circuit is within 6 ft. of any switch or fitting on the other circuit. The distribution boards of the general lighting and of the pilot lighting are placed so far apart that no man working on one can, even intentionally, touch the other. Moreover, they are divided into two halves, so that while the fuses can be replaced only by the electrician the switches can be turned on or off by the ordinary attendants.

To make further separation the two sets of circuits receiving energy from the two sources of supply are provided with different colored wires, red and black being used on one circuit and blue and yellow covered wires on the other.

The switches throughout the building are of the flush type, with the exception of those on the service and fifth floors; Lundberg plugs are used throughout, and where heating circuits are employed a device is employed to prevent the heating plug being inserted in the lighting socket and vice versa.

RECENT TELEPHONE PATENTS.

CONNECTING CALL CIRCUIT.

It is probably well recognized that one of the points of the common battery switchboard which merits improvement is the device for recalling the operator after a connection is established. The percentage of calls in which such a recall is necessary is small, yet most telephone users have experienced inconvenience at some time or other due to inability to attract the attention of the operator.

In a patent recently granted Mr. R. H. Manson, of Elyria, Ohio, the disconnection has been placed absolutely under control of the subscribers. To this end the inventor arranges the cord circuit so that both plugs may be disconnected by means of cut-off relays. These relays respond to a vibration of the hook switch, provided a predetermined and sufficient time has elapsed since the establishing of the connection. A slow-acting relay, held back by a dashpot, controls the circuits and no flashing has any effect until it has completed its travel. When the plug ends are cut off, each line involved returns to normal condition as though not connected and ready for other calls. The operator removes the plugs at convenience, when everything returns to normal. The Dean Electric Company is assigned this patent.

COOLED TRANSMITTER.

Messrs. C. E. Enger and G. Holmström, of Sweden, have patented a transmitter cooled by a high-resistance heat-absorbing liquid. A vessel is arranged in the rear of the transmitter casing and the back ends of the stationary electrodes protrude through the wall. As the electrodes are bored out the liquid fills the space within them.

LETTERS TO THE EDITOR.

Depreciation.

To the Editor of the Electrical World:

Sir:—Referring to Mr. H. G. D. Nutting's article in your issue of Aug. 5, it would be interesting to know what the author means by the "value in dollars" graphically set forth in his curve reproduced on the next page. I have always thought that the value of a thing was the price it would fetch. If such is the case I cannot see how the curve comes to have so many kinks and sharp corners, for obviously the sale value or replacement value is not subject to any sudden variations arising from the depreciation of the apparatus.

Perhaps the explanation of this anomaly is that Mr. Nutting meant to say "utility" instead of "value in dollars," when the curve would become clear and enlightening. It is, however, hopeless to try to measure utility in dollars. The dollar will no more measure utility than a yard-stick will measure weight and for the same reason. The reason is that a measure must have the same physical dimensions as the quantity it measures. Thus the unit of length must have the dimensions (L), and the unit of weight must have the dimensions (MLT^{-2}), simply because those are the dimensions of the quantities they measure. What are the physical dimensions of utility? Does anyone know? Take the case of the Corliss engine cited by Mr. Nutting; its utility depends upon its efficiency, its size, its speed and many other things. Hence the physical dimensions of its utility (were it measurable) would be very complicated and would probably involve L, M and T in complicated powers. This complex quantity cannot be measured in dollars because the physical dimensions of a dollar are those of a mere number. Value as defined in modern works on money is also a mere number and therefore, unlike utility, is capable of expression in money, which is, in fact, its measure.

The writer takes the liberty of making this criticism because much of the existing literature on depreciation is marred by lack of appreciation of the nature of value and money, especially by forgetting that money is a measure and therefore subject to the physical laws that govern all measures.

New York. WILLIAM A. DEL MAR.

To the Editor of the Electrical World:

SIR: The article by Mr. H. G. D. Nutting on "Depreciation," in the Aug. 5 issue, brings out an interesting point in relation to the rate of advance of depreciation.

It has been assumed by many engineers that a compound interest sinking-fund curve is a proper one to use in fixing present values of depreciated physical property. But this is by no means the universal view.

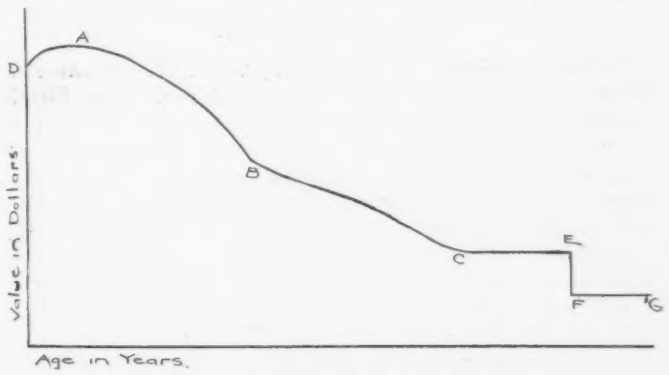
Mr. Nutting apparently believes the sinking-fund curve is a proper method and applies it in the depreciation curve in his article, between the points A and B. This curve is very interesting because it conforms with many conditions of actual experience. Now let us look at the entire curve from D to F. The part $D\ A\ B$ is convex upward; the part $B\ C$ is nearly straight, and $C\ E\ F$ is convex upward. Looking at the part $A\ B\ C\ E$, it is concave upward.

If D is the initial value—or perhaps some point between D and A—and F is the final value, then it is interesting to see what type of uniform curve or line represents the actual depreciation most closely.

A sinking-fund curve from D or A to F would not agree with the actual curve Mr. Nutting has drawn, except perhaps at the ends. It would be much too high near the center, over B and C. A straight line, however, starting just above D and passing slightly below A, over and parallel to $B\ C$, under E and intersecting the line $F\ G$ just beyond F, would compare favorably with the actual curve.

In other words, the actual curve more closely approximates a straight line than a sinking-fund curve. Thus it tends to uphold the straight-line theory rather than the curve theory.

I quite agree with Mr. Nutting that no set method or



Curve Showing Depreciation of Apparatus.

theory of depreciation fits every sort and kind of condition, but in the case of a going public utility I believe a straight line more nearly represents the advance of depreciation and is a better guide to present value than the sinking-fund curve. If physical property does depreciate, in fact, in a manner which causes present values to coincide with the curve, the connection is a mere coincidence and not one of actual relationship. On the other hand, the straight-line theory is supported by strong economic arguments.

Perhaps the underlying reason for the use of the sinking-fund method is its economy. Many assume that the straight-line method is not economical because there will be no interest on the fund. This is not the case and the straight-line method may have the advantage of interest on the fund as much as in the other method. On the score of average annual assessments to cover depreciation there is little difference in cost between the two methods, with a slight advantage in favor of the straight-line method.

Chicago, Ill. FRANK F. FOWLE.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Alternating-Current Commutator Motor.—OSSANNA.—The conclusion of his paper on the design of single-phase commutator motors with special reference to heavy traction. The author gives a series of formulas for dimensioning the usual single-phase commutator motors with reference to sparking while starting or running and with reference to the other characteristic features of the motors under discussion. The author concludes that the series motor is superior to the repulsion motor. This superiority of the series motor is found to rest in the fact that at full torque it can run sparklessly at a speed far above synchronism (at three or four times synchronous speed). With the repulsion motors under discussion this is not possible and this is the reason of their inferiority, but this would disappear at once if means could be found of operating at speeds other than synchronism. For heavy traction a lower frequency, say, 15 cycles per second, is better than a higher one, say, 25.—*Elek. Zeit.*, June 23.

Comparative Ratings of Alternators.—B. G. LAMME.—A long paper illustrated by numerous diagrams in which the author discusses some of the popular misconceptions regarding the relative polyphase and single-phase outputs which can be obtained from a given winding, and then gives a correct summary of the comparative ratings of alternators for polyphase and single-phase currents. Three-phase windings and six-phase windings are first discussed. A comparison is made of single-phase and three-phase ratings on the basis of equal losses in a given coil or group and on the basis of equal total armature copper loss. Two-phase and three-phase ratings are then compared and single-phase ratings from two-phase wind-

ings are discussed. A comparison is made of the permissible alternating-current and direct-current outputs from the same armature winding. Up to this point only the armature copper losses are taken into account. The author then discusses the field-coil heating. Among the various types of alternating-current windings the three-phase true star type of winding is the one which, in general, lends itself to best advantage to the various types of alternating-current machinery. Where windings other than the true star winding are used there is usually some condition which is more important than the output. The author gives some of the principal applications of the different types of windings, especially closed-coil windings, three-phase star windings and delta-type windings.—*Elec. Journal,* August.

Lamps and Lighting.

Radiant Efficiency of Arc Lamps.—H. P. Gage.—An abstract of a paper read before the American Physical Society. The object of the investigation was to determine the radiant efficiency of arc lamps and the mechanical equivalent of light. The definition used for radiant efficiency is: Ratio of energy of the visible part of the spectrum to total energy radiated $= L \div R$. Using the symbols $R =$ total energy radiated, $W =$ energy passing through an 8-cm layer of water, $L =$ energy in visible part of spectrum. The ratio L/R or W/R was obtained by a slight modification of the method of Ängström. After dispersing the spectrum of a light source the infra-red was removed by an opaque screen. The light was then reassembled by a mirror to a white spot. The energy of the white light was compared by means of a radiomicrometer with white light of equal intensity and like color from the same source which had not been robbed of its infra-red. In some cases, owing to the small value of L compared with R, L was compared with the intermediate quantity W. The most important results follow:

Source.	Efficiency. L/R per Cent.	Light Equivalent, Candles per Watt.
Positive crater, right-angle carbon arc	8 to 12 depending on current	30
Right-angle lamp, alternating current	6.5 to 8.5	21
Yellow flame arc	15.4	39
Yellow flame, arc stream	39.0	....
Brilliant white	14.6	21
Hefner, recalculated from Angstrom for limit 0.68μ	0.363	21.3
Nernst lamp viewed through $CuSO_4$ solution	100.0	39.5

The greatest efficiency of 39 per cent was found in the case of the arc stream between yellow-flame electrodes, the tips being shaded. The light equivalent was found to to be as high as 30 candles per watt with white light and almost 40 candles per watt with light distributed more in the visually intense part of the spectrum.—*Phys. Review,* June.

Lamp Characterstics.—M. Tappley.—The conclusion of his article giving various notes on electric lamps. The author deals with the rating of arc lamps and gives tables of the usual candle-power units in which different kinds of incandescent and arc lamps are being made. He then deals with ageing and with burning hours and gives the following formula for the most economical life of a filament lamp, assuming constant wattage and steady decay of candle-power. Best life in hours for minimum cost per

$$\text{cp-hour} = \frac{1000\,k}{pw}\left(\sqrt{1+\frac{0.002\,Cr}{ks}}-1\right)$$

where $w =$ wattage of lamps; $2p =$ cents per kw-hour; $2k =$ cost of lamp (in cents); $C =$ initial candle-power; $c =$ candle-power after t hours; $r = pwt$; $s = C - c$. He finally gives data on the usual voltages and currents for incandescent and arc lamps. He states that it is not generally realized how considerably the power-factor of a pure lighting load may depart from unity. The power-factor of filament lamps is practically 100 per cent, but few arc lamps have a power-factor, terminal to terminal, higher than 85 per cent, or rarely 90 per cent, while in many instances the figure falls to 70 per cent; the power-factor of the arc itself is usually from 85 per cent to 90 per cent. In general, 80 per cent may be assumed for the power-factor of the whole arc lamp and 90 per cent for that of the arc alone. The power-factor of a mercury arc is from 80 per cent to 85 per cent, while that of a nitrogen-vapor tube may be 90 per cent or more.—Lond. *Elec. Review,* July 28.

Neon Luminescent Lamp.—G. Claude.—A French Academy paper in which the author discusses some further developments of his neon lamp. With the Moore lamp it is necessary to provide a valve which introduces at regular intervals new gas into the tube. This the author endeavored to avoid with the neon lamp. He found that the troubles are essentially due to a vaporization of the electrodes. Interesting data are given of deposits resulting therefrom and the discovery of helium in exhausted tubes. He found that all that is necessary is to prevent the vaporization of the electrodes, and this is possible by making them large enough. He states that it is now possible to make neon tubes of a length of from 5 m to 6 m, the specific power consumption being 0.8 watt per candle-power.—*L'Industrie Elec.,* July 10.

Generation, Transmission and Distribution.

Alternating-Current Motors for Elevator Service.—A. G. Popcke.—An article on the selection of alternating-current motors for elevator service. With the diameter of the elevator drum, the speed of the car and the unbalanced load known, in selecting a motor it is necessary to determine the required horse-power and the motor speed. The author gives two diagrams from which both the horse-power and the speed can be easily found and gives numerical examples of the points of these diagrams. In practice it has been found that squirrel-cage motors in sizes up to 20 hp are satisfactory for elevator service. A speed of 720 r.p.m. has been found to be most desirable. Therefore, eight-pole, 60-cycle motors of the squirrel-cage type are mostly used for this kind of service. Where a starting current of 2.5 times full load is objectionable and when the size of the motor exceeds 20 hp a wound secondary motor is commonly used.—*Elec. Journal,* August.

Abnormal Pressure Rises on High-Tension Alternating Circuits.—J. R. Dick.—The author first gives a mechanical analogy of the phenomenon of resonance and then discusses methods of preventing resonance. He then takes up pressure rises produced on closing a circuit containing capacity and inductance. These phenomena are often loosely ascribed to resonance, which is misleading. To make use of a mechanical analogy, they are closely akin to the impact of a load on an elastic body. Finally he discusses pressure rises on switching off heavy currents. These are frequently spoken of as being due to resonance, but, although oscillations are produced when a heavy current is broken, there can be no resonance, as the original forced vibration has ceased with the breaking of the current. A mechanical analogy is that of striking a blow on a tuning fork.—Lond. *Electrician,* July 28.

Energy Supply in a Pottery District.—An illustrated article on the energy supply in the pottery district in Staffordshire. The total area is 11,154 acres, the population 245,000. The total horse-power of electric, steam and gas plants engaged in the staple industry of the district, the manufacture of pottery and china, and in other minor industries is 10,000 hp, and of this approximately one-third is already electric. Electricity is at present supplied from four generating stations, but it is not intended to make

additions to these in the future, but to build and equip a new power station as nearly as possible in the center of the area. This will be connected with the four existing stations by trunk mains and will contain two 1500-kw turbo-alternators.—Lond. *Elec. Eng'ing*, July 27.

Electricity in Textile Mills.—An illustrated article giving some notes on the development of electric driving in British textile mills.—Lond. *Electrician*, July 28.

Traction.

Electrolysis of Water Pipes.—E. E. LANPHER AND L. B. SMITH.—A paper presented before the Engineers' Society of Western Pennsylvania on electrolytic destruction of water-system underground structures in Pittsburgh. The authors' final conclusion is that the only certain method of preventing electrolysis is the installation of the double-trolley system and the most successful method of mitigating electrolysis is the installation of the return-pipe feeder system. The latter system was applied in Pittsburgh. An account is given of the long discussion which followed. The adoption of the "return-pipe feeder system" was severely criticised by several speakers, especially by Mr. A. F. Ganz, who referred to the radial-insulated return system as the one system which has universal recognition and which is the only one which has correct theoretical foundation. Mr. L. B. Smith reported some interesting results of a survey made on June 28, 1909. On this date no cars except mail cars were in operation, a universal strike having been declared on the previous day. In the one day two city corps covered practically all districts which were normally "danger zones" and noted electrolytic conditions differing widely from anything observed before or since; that is (a) the major part of districts ordinarily positive were on this date slightly negative. (b) No positive reading greater than 0.15 volt was discovered except where observation was taken while a mail car was in the vicinity. (c) Wherever positive readings existed the potential was materially reduced, so that in many cases a millivoltmeter was required in order to measure the emf. The data thus offered furnishes unusual evidence of the prime source of the electrolytic trouble in Pittsburgh and would indicate that with no street cars in service the districts of positive potential on the water mains would entirely disappear.—*Proc. Engineers' Society of Western Penna.*, July.

Tramway Problems.—C. W. MALLINS.—An illustrated paper read before the Edinburgh Congress of Tramways and Light Railways Association. The author gives data and diagrams on the cost of construction of permanent way and overhead equipment and cost of maintenance of track for twelve typical undertakings. He also discusses the best type of car to be used and rates to be charged. He states that in Great Britain tramways and light railways are carrying the general public at very little more than half the fares charged by railway companies. The railway companies derive an all-round rate of 2 cents per mile per passenger. The author advocates the transport of merchandise by tramways and light railways. The subject of transfer fares is discussed in another paper by Mr. C. W. Shepherd before the same congress.—Lond. *Electrician*, July 28.

Single-Phase Traction.—W. USBECK.—The conclusion of the fully illustrated detailed description of the overhead-line construction of the single-phase railroad from Dessau to Bitterfeld, in Germany. The subdivision of the line into sections and the overhead construction at difficult crossings, etc., are described and illustrated.—*Elek. Zeit.*, June 29 and July 6.

Financial Results from Traction Systems.—G. SOBERSKI.—An article discussing the fundamental points which determine the financial results obtained from traction systems, with special reference to tariff and management so as to increase as much as possible the receipts and reduce the expenses.—*Elek. Zeit.*, July 6.

Electric Propulsion of Ships.—A note on the electrical equipment of a British coast liner, the generating equipment of which comprises a gasoline engine of 35 hp, which drives a three-phase alternator, where energy is supplied to an alternating-current motor on the propeller shaft. An induction motor is used without brushes or slip-rings and of the "multiple-wound" type, eight-pole and twelve-pole windings being used. The generator also has two windings (four-pole and six-pole) corresponding with those of the motor, and the various speeds are obtained by combinations of the windings.—Lond. *Electrician*, July 28.

Installations, Systems and Appliances.

Domestic Uses of Electricity.—G. DETTMAR.—The first parts of a very long paper presented at a recent meeting of the German Association of Electrical Engineers. The author urges the co-operation of the electrical engineers with their wives to increase the popularity of the domestic uses of electricity. He first deals with electric lighting and states that in residences tungsten lamps are now used almost exclusively. Carbon lamps are used only where they are employed for short times of lighting or where a long candle-power with a high voltage is required or where they are subjected to serious mechanical vibrations. However, he describes some experiments which show that the modern tungsten lamp is no longer fragile and can withstand vibrations and motions quite well. The easy switching on and off of electric lamps is an advantage which is not sufficiently appreciated. With gas lamps experience shows that generally twice as many lamps are being lighted as are actually needed. The author figures that if one goes into a dark room to get something for a moment the use of a match alone for a few seconds is seven times as expensive as lighting an electric lamp for the same time. Electric lamps can be used in all sizes according to requirements; they develop little heat; their color is good, although the metallic-filament lamp has too high a brightness under some circumstances, so that the use of frosted globes, etc., becomes necessary. The easy replacement of a broken lamp by a new one is a very great advantage. Gas engineers now appreciate the importance of the ease and convenience of electric lamps and several gas plants in Germany are now offering to keep their customers' gas incandescent lamps in good order at a regular rate which is not more than cost. At one plant the yearly rate per incandescent gas lamp is between $1.12 and 75 cents per lamp according to the number of lamps. This is almost half the cost of the gas itself, but is hardly ever taken into consideration in comparisons between gas and electric lighting, although it is a very important factor. Moreover, the electric lamp is clean and hygienic, while considerable data are given on the deterioration of air by gas lamps. The danger of explosion from gas lamps is also pointed out. The advantages of electric lamps are now so well recognized in Germany that at present use is made of 50,000,000 incandescent electric lamps and 2,000,000 arc lamps against 25,000,000 gas lamps. In an ordinary household the cost of lighting and heating in Germany is 4 per cent and a slightly higher expense for a better light is well justified, just as paying higher prices for better clothing and better food. While the production of gas in Germany in the months of November and December, 1910, was only 4.9 per cent higher than in the corresponding months of 1909 the kw-hours produced increased in the same year by 16.5 per cent. The author thinks that the use of gas for lighting is decreasing in Germany and that the increased production of gas is due to the use of gas for other purposes. The paper is to be continued.—*Elek. Zeit.*, June 29 and July 6.

Control of Power-Factor in Three-Phase Installations.—W. GENKIN.—A description of a method in which two

meters are arranged according to the well-known two-wattmeter method. The principle is indicated in Fig. 1. The current coils of the two meters I and II are connected in series. The excitation coils of meter I are con-

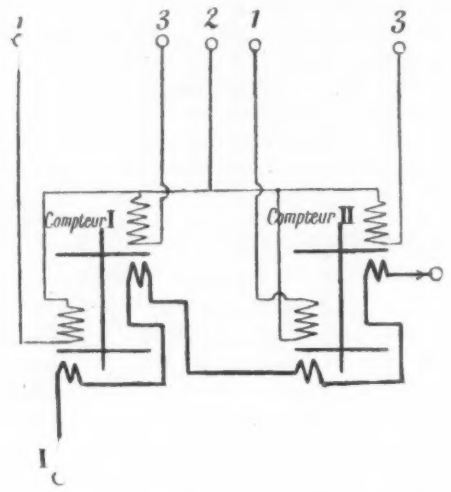


Fig. 1—Wattmeter Connections.

nected in the ordinary normal way, while the connections of one of the excitation coils of meter II are reversed. Under these conditions meter I measures the real power, while meter II measures the wattless volt-amperes. In order to apply the method to the frequent case of a transformer, the primary of which is connected in delta fashion and the secondary in star fashion, the connections shown in Fig. 2 are used. The series transformers I_1 and I_2 deliver current to the series coils of the meter through the terminals *I*. The points 1, 2 and 3 on the low-tension side are connected to the corresponding points of the pre-

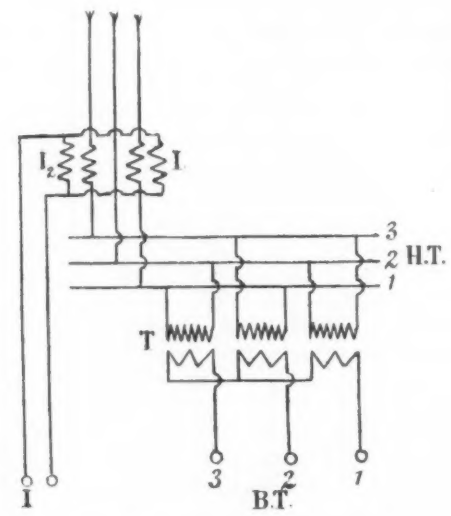


Fig. 2—Transformer Connections.

ceding figure. In contradistinction to the preceding case the meter I records now the wattless volt-amperes and the meter II the real power.—*La Lumière Elec.*, June 3.

Russian Central Stations.—Statistical data on the 156 central stations in Russia. Detailed figures are given for only 111 stations. Of these eighty-one use direct current, five direct current and alternating current and twenty-four alternating current; the emf being between 5000 volts and 8000 volts in four stations; between 2000 volts and 3000 volts in twenty-one stations; between 500 volts and 600 volts in three; between 150 volts and 240 volts in sixty-three, and between 110 volts and 150 volts in twenty stations. Out of thirty-seven stations for which complete data are available, fifteen have a rating below 500 kw, six up to 1000 kw, seven up to 5000 kw, five up to 10,000 kw and four up to 20,000 kw. The total rating of these thirty-seven stations is 117,141 kw. They include four stations in St. Petersburg, with an aggregate rating of 41,630 kw. The price of the kw-hour for lighting is between 8 cents and 27 cents and for motor purposes between 4 cents and 16 cents. Thirty stations are operated by steam, four by gas and three by steam and gas.—*Elektrischestwo*, No. 6, 1911; *Elek. Zeit.*, July 6.

Electricity on Board Ship.—The first part of an illustrated article in which are described the various uses to which electricity is put on board the two White Star liners, the *Olympic* and *Titanic*. These include, besides lighting, energy for winches, cranes, fans, water-tight doors and stoking-helm indicators. The clocks and heating equipment are also electrically worked, while a complete telephone and wireless installation is found on board. The differences between marine and land practice are noted.—Lond. *Electrician*, July 28.

Protective Relays.—K. Edgcumbe.—An illustrated paper in which the author describes some protective relays for alternating-current circuits. The following relays are discussed in succession: (1) Overload relays; (2) no-voltage or minimum relays; (3) reverse-power or discriminating relays; (4) differential or balanced relays. In the present instalment overload relays are dealt with. The paper is to be continued.—Lond. *Elec. Review*, July 28.

Wires, Wiring and Conduits.

Laying of Mains.—W. G. Turner.—The author emphasizes the great importance of careful initial laying of mains on the solid system and gives various practical hints and precautions with reference to rubber or bitumen-insulated cables.—Lond. *Elec. Eng'ing*, July 27.

Electrophysics and Magnetism.

Molecular Attraction.—J. E. Mills.—A highly theoretical paper on the relation of temperatures and molecular attraction. The chief result is that a change of temperature does not change the nature or the amount of the molecular attractive force. The temperature merely determines the orbit that the molecules will follow in obedience to the attractive force.—*Phil. Mag.*, July.

Electronic Theory.—S. B. McLaren.—A highly mathematical paper on the emission and absorption of energy by electrons. Lorentz's theory of complete radiation is extended to all wave-lengths.—*Phil. Mag.*, July.

Units, Measurements and Instruments.

The Bureau of Standards' Current Balances.—E. B. Rosa, N. E. Dorsey and J. M. Miller.—An abstract of a paper presented before the American Physical Society. The current balances of the Bureau of Standards are of the type used by Lord Rayleigh, each consisting of a pair of fixed coils of equal radii and of square cross-section, and fixed at such a distance apart that the force upon the moving coil, also of square cross-section but of a smaller radius, suspended midway between the fixed coils and coaxial with them, is a maximum. The final weighings show that the emf of the Weston normal reference cells of the Bureau of Standards is 1.01823 volts, in terms of the international ohm. That is, the Weston cells have an emf of 1.01823 absolute volts if the international ohm is equal to the absolute ohm. The value of the emf of these coils is 1.01830 international volts (in terms of the international ohm and the silver voltameter), showing an apparent difference between the absolute volt and the international volt of 0.00007 volt. However, there is perhaps a greater difference than this between the absolute ohm and the international ohm, hence it cannot be said definitely until the absolute ohm is better determined whether the international volt or the absolute volt is the larger. The above result and those obtained by other observers during the last four years seem to indicate that the

emf of the Weston normal cell at 20 deg. C. in terms of the international ohm and the absolute ampere is 1.01822 volts to within a few parts in 100,000.—*Phys. Review,* June.

Testing High-Tension Cables.—An illustrated description

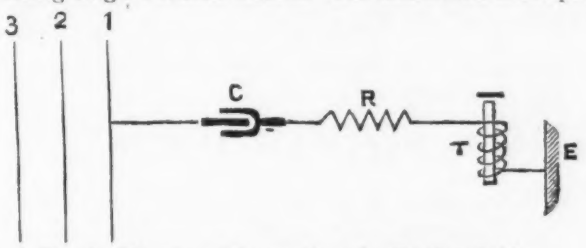


Fig. 3—Diagram of Connections for Testing Cables.

of a simple apparatus called the "phasophone" for the detection and localization of potential faults of high-tension cables. As shown in Figs. 3 and 4 the essential components are a high-tension mica condenser *C,* a non-inductive resistor *R* (of over 1 megohm resistance), a spark micrometer *f* and a telephone receiver *T*. The manner of connecting these is shown diagrammatically in Fig. 3, the actual arrangement being as in Fig. 4 (which is a plan of the essential parts of the apparatus; dotted connections are internal; low-tension terminals are shown by single rings and high-tension terminals by double rings). The condenser, non-inductive resistor and telephone are connected in series between one line wire and earth. The capacity current then flowing through this auxiliary circuit sets up a note in *T* of a pitch dependent on the frequency of the main current. So long as the whole installation is in perfect order the note emitted by *T* is uniform, but should the slightest irregularity arise (such as current leakage, sparking to earth, bad contacts, faulty operation of parallel machines, load oscillations, unbalanced phases, excessive discharge at spark-gaps, and so on), indication thereof is at once given in a definite and recognizable manner in the phasophone. The current taken by the phasophone at 5000 volts line pressure corresponds roughly to an equivalent resistance of 15,000,000 ohms, so that the leakage or sparking at any fault offering less than 15 megohms resistance strongly affects the telephone note.

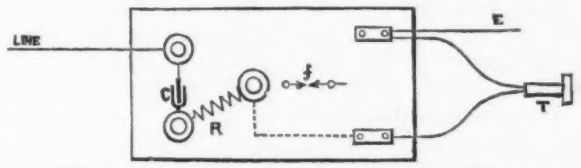


Fig. 4—Plan of Apparatus for Testing Cables.

Other faults of a similar magnitude are easily detected. The telephone (Fig. 4) may be at any reasonable distance from the rest of the apparatus.—Lond. *Elec. Review,* July 28.

Meters.—H. W. RICHARDSON.—After some general remarks on various types of electric meters and on the use of prepayment meters, he discusses high-torque and low-torque meters, the way in which retardation depends on magnetic drive and friction, the effect of friction and necessity for light-load compensation, he points out that high torque is more important than weight of moving element in minimizing friction effect. Notes are added on ball bearings and pivot bearings, on the exaggerated importance which is often laid on shunt losses, on the care which must be taken in the selection of the location of the meter and in its installation, on the importance of regular inspection and testing and on the life of the jewels.—*Gen. Elec. Review,* August.

Telegraphy, Telephony and Signals.

Loading a Long Telephone Line with Inductance Coils.—L. CAHEN.—The first part of a mathematical paper in which the author discusses how to load a long telephone line with Pupin inductance coils in order to obtain the maximum possible advantage. In the present instalment he gives the fundamental formulas and discusses in detail the effects of a change of self-induction, all other characteristic properties of the line remaining unchanged. He emphasizes the practical importance which the insulation resistance of the line has for the problem.—*La Lumière Elec.,* June 3.

Miscellaneous.

Apprenticeship.—G. STIER.—An article giving a summary of the regulations in force in Germany for the keeping of apprentices and discussing methods of training the apprentices in the mechanical industries and their further education in schools (Fortbildungschulen).—*Elek. Zeit.,* June 29.

BOOK REVIEWS.

A STUDY OF ELECTROTHERMAL AND ELECTROLYTIC INDUSTRIES, By Edgar A. Ashcroft. Vol. I. New York: McGraw-Hill Book Company. 130 pages, 37 illus. Price, $2.

The book is divided into six chapters, dealing respectively with history of the subject, theory of electrochemistry, electrochemical and electrothermal calculations. value of electrochemical and electrothermal processes, general designs for industrial plants and the production of cheap electrical energy. The book is remarkable in its intellectual aspect, for it combines a number of statistical and commercial facts on the one side with speculative and social philosophy on the other, with electrochemical considerations as a sort of binding material. The philosophy is very interestingly written, the statistics are very practical and the electrochemistry is very clearly expressed. The book will be welcome to students of industrial electrochemistry, to electrochemical engineers and to thinking men generally.

DIE UNIPOLARE GLEICHSTROMMASCHINE. A thesis for the Doctorate of Engineering. By Boris von Ugrimoff. Berlin: Julius Springer. 99 pages, 104 illus.

The thesis commences with a history of the development of commutatorless machines for direct current. Special attention is given to the description of the Noegerrath machine. The second chapter deals with a research on high-speed rubbing contacts. A third chapter discusses the mathematical theory of high-speed cooled rubbing contacts. The fourth describes the construction of a particular type of machine designed by the author; while the fifth details the tests made on said machine.

MESURES ÉLECTRIQUES INDUSTRIELLES. By J. A. Montpellier and M. Aliamet. Paris: H. Dunod et E. Pinat. 468 pages, 328 illus. Price, 19.50 francs.

This is the third volume of a series of books by the same authors on industrial measurements and tests. It is divided into eighteen chapters, dealing successively with the following topics: Electromagnetic quantities; general considerations; electrostatic instruments; electromagnetic instruments; electrodynamic instruments; induction instruments; thermic instruments; auxiliary apparatus; resistance measurements; emf measurements; current measurements; quantity measurements; capacity measurements; power measurements; energy measurements; special alternating-current measurements; watt-hour meters.

The book is very logically arranged, clearly written and well illustrated. It is also well up to date. The treatment is arithmetical with elementary algebra. The book is an excellent guide to the principles and modes of operation of electrotechnical measuring instruments, and will be of value to the student of electricity and the measuring engineer.

Grundegesetze der Wechselstromtheorie. By Fritz Hoppe. Leipzig: J. A. Barth. 146 pages, 160 illus. Price, 5 marks.

A good elementary treatise on alternating currents from the standpoint of vector diagrams. Rectangular co-ordinates, crank diagrams and polar diagrams are compared and their respective curves developed for a number of cases. Attention is paid in considerable detail to the wave forms of alternating-current generators and the methods of computing the same. The work is thoroughly practical and well adapted to the needs of the student of elementary alternating-current engineering.

New Apparatus and Appliances

AUTOMOBILE TROUBLE FINDER.

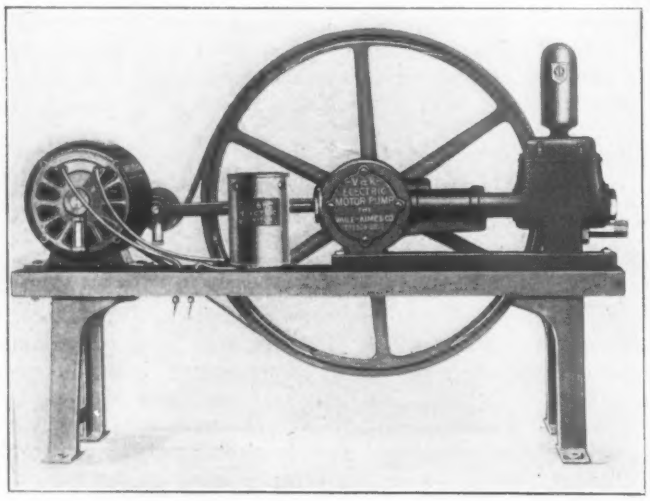
The McGill Manufacturing Company, of Valparaiso, Ind., is putting on the market an automobile "trouble finder," to which the trade name "Thumswitch" is given. As will be seen, it consists of a small lampholder and

Portable Miniature Lamp.

guard with a switch enabling the light to be controlled at the will of the user. By its use troubles about an automobile may be quickly located and the danger of explosion and injury caused by broken or hot lamps coming in contact with oils is avoided. It is made with a solid brass guard, an attractive handle and is furnished complete with cord and terminal, which may be attached to any battery. Any miniature lamp, carbon or tungsten may be used of from 2 volts to 6 volts.

MOTOR-DRIVEN HOUSE PUMP.

One of the problems that often confronts the property owner in rural and suburban districts is a troublesome and more or less crude water system. The Vaile-Kimes Company, of Dayton, Ohio, manufactures an electric-motor pump which, when installed with a compression or pneumatic tank, gives an independent reliable automatic water



Motor-Driven House Pump.

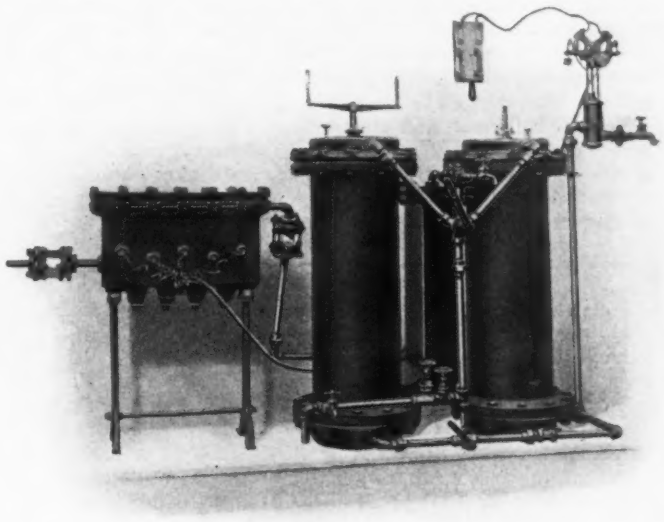
supply for all purposes. It pumps the water direct from the cistern, well, lake or stream into a tank under pressure, whence it is distributed for use.

In cities where water rates are high or where the pressure is low, and where homes are supplied with electricity, this system forms an efficient and inexpensive means of water supply. It is of sufficient capacity to furnish the average suburban home with water under pressure for bathrooms, kitchen, laundry and sprinkling purposes. The power is obtained from a ⅛-hp Westinghouse motor of the type extensively used for the operation of small machines. For ordinary service the motor is so well designed and built that the cost of energy consumed does not exceed 2 cents an hour. An automatic switch governed by the water pressure in the system controls the operation of the motor. This switch starts the motor automatically when the pressure falls to a given point, and stops the motor when the maximum desired pressure is reached. No attention is, therefore, required to keep up the water supply. The pump is belt-driven and is equipped with an automatic belt tightener which keeps the belt always tight. A large air chamber makes the discharge smooth and uniform. The pump may be arranged for mounting on the wall by substituting brackets instead of the legs.

ELECTRICAL PURIFICATION OF DRINKING WATER.

Within recent years there has been introduced a system for the electric purification of water which is said to overcome the inherent drawbacks of other systems. By the electric purification no chemicals or other substances are introduced into the water, nor does the electric action on the water remove any of the natural salts or gases. The electric system of purification has been recognized by scientists and laboratory experts for more than forty years, but it is stated that, until the introduction of the electric water-purifying machine it has never been made commercial. The system as used to-day is illustrated herewith and briefly described below. The machine is attached to any feed pipe connecting with the main from which the water is forced, under the existing pressure, into the electrode box (the square casting resting on standard to the left). This box is divided by a series of electrodes into separate compartments, the water filling the first compartment, overflowing into the next and so on until it is forced out into the settling chamber. During this operation the process of purification is accomplished by the action of the electric current in conjunction with the aluminum electrodes acting upon the water. The aluminum electrodes throw off aluminum hydroxide which permeates the entire body of water, forming a flocculent or sponge-like mass which surrounds all the animal and vegetable organisms, together with all other impurities that are in suspension, and forms a precipitate. It is claimed that concurrently a partial dissociation or separation of the elements takes place, hydrogen and oxygen being liberated in their nascent forms. In this state the oxygen has its greatest oxidizing and germicidal properties and, together with the hydroxide, energetically attacks all lower forms of animal and vegetable life. As previously stated, the water is then passed into the settling chamber (the square compartment between the two cylinders in the illustration) to give the hydroxide further action on the water and to permit the water to absorb the gases. The water is next passed through the two cylinders which are filled with white granite

quartz, crushed to about the same consistency as granulated sugar. These cylinders with their quartz contents are merely filter beds through which the water is passed in order to remove the impurities which have been previously surrounded by the hydroxide.



Electric Filter.

From the filter beds the water is carried through the outlet at the extreme right in the illustration, or can be piped for an indefinite length throughout a building, with as many faucets as desired. The water is now ready for use and will be found clear as crystal, pure, sparkling and palatable, but still containing the life-giving properties provided by Nature, namely, the essential salts and gases. This fact has been demonstrated by many hundreds of chemical and bacteriological tests and is further vouched for by the diversified and high character of the users of the system.

The machines are standardized and are built in various units to supply existing demands. Considering the result obtained the cost of installation is small and the expense of operation is practically only the cost of the small amount of energy required. The construction of the machine is simple and solid. There are no moving parts other than the contact valve, which is strongly constructed, and the polarity changer, where direct current is supplied. Where alternating current is used no polarity changer is needed.

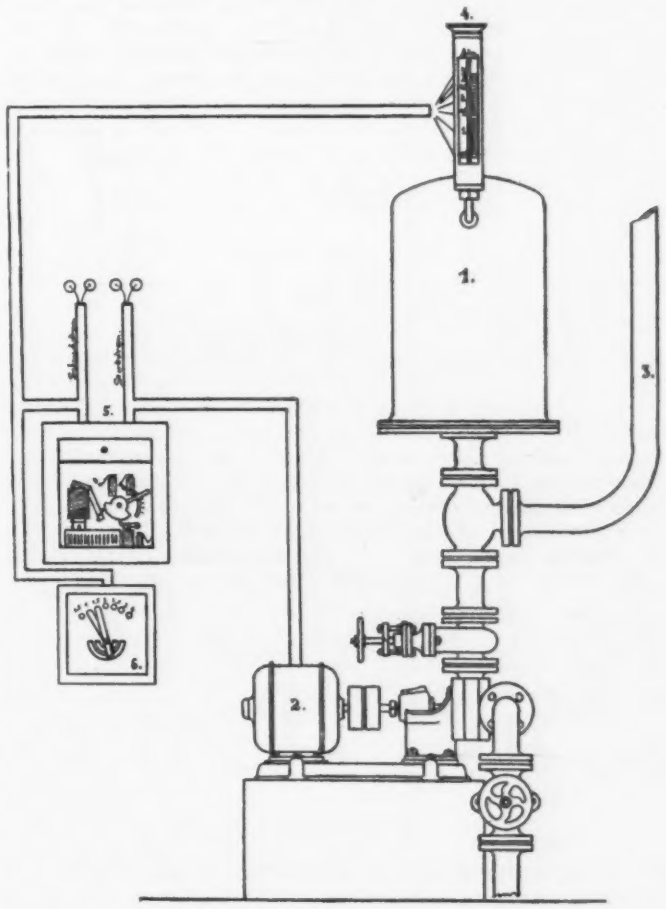
In operation the machine requires only a regular flushing of the filter bed by reversing the water current and removing the impurities through a drain pipe provided for that purpose. While flushing the machine the quartz in the filter is agitated by means of the detachable handle shown in the illustration, which fits on vertical shafts with blade attachments extending through the center of the cylinders.

Among those who have installed and are using this machine may be mentioned the following: Carnegie Steel Company, Pittsburgh, Pa.; Western Pennsylvania Institute for Deaf and Dumb, Wilkinsburg, Pa.; Western Pennsylvania Institute for Blind, Pittsburgh, Pa.; Colonial Trust Company, Pittsburgh, Pa.; Boggs & Buhl, Pittsburgh, Pa.; Westinghouse Machine Company, East Pittsburgh, Pa.; Union Trust Company, Pittsburgh, Pa.; George Westinghouse, Pittsburgh, Pa.; Huyler's, Pittsburgh, Pa.; Pittsburgh Trust Company, Pittsburgh, Pa.; Fidelity Title & Trust Company, Pittsburgh, Pa.; George F. MacDonald, confectioner, Pittsburgh, Pa.; Allegheny Theological Seminary, Pittsburgh, Pa.; The Philadelphia Company, Pittsburgh, Pa.; May Drug Company, Pittsburgh, Pa.; Kenyon Theater, Pittsburgh, Pa.; Rosenabum Company, Pittsburgh, Pa.; Superior Steel Company, Carnegie, Pa.; Johnstown Public Schools, Johnstown, Pa.; Lawrence Club, New Castle, Pa.; Carl H. Schultz, Inc., New York, N. Y., and the Hotel Martinique, New York, N. Y.

The above described apparatus is built by the American Electric Water-Purifying Machine Company, the New York sales office of which is in the Fifth Avenue Building.

AUTOMATICALLY CONTROLLED WATER-PUMPING SYSTEM.

An automatically controlled motor-driven pumping system, built by Rennert & Company, of Munich, Germany, is illustrated in the accompanying sketch. The outfit comprises a motor-driven centrifugal pump delivering into a system of mains to which is connected an air bell capable of withstanding pressures up to several atmospheres. When the pump is started the water rises in the bell, compressing the air above it until a pressure of about 60 lb is obtained, when the motor is automaticaly shut off through a relay switch controlled by a mercury-contact manometer. Demands for water are then supplied by the force of the compressed air in the bell, or "hydrophor," until this pressure has fallen to a point where the lower-limit contact of the manometer operates to restart the motor. The motor is automatically accelerated by the starting mechanism shown. Below the starter is the double-lever switch for adjusting the desired pressure limits at which the manometer acts to start and stop the motor. The manufacturer has applied a similar scheme to providing boiler-feed water as needed by boilers. This device is fitted with auxiliary alarm signals which operate when the allowable level limits are exceeded. Another application of the manometer control is its use in an automatic reducing valve, with which gradual pressure reductions can be attained as low as 0.01 atmosphere. The contact relay, controlled by a thermometer, has also been used for maintaining constant the temperature of heating systems, drying-rooms, etc.



Automatically Controlled Water-Pumping System.

Industrial and Commercial News

The Week in Trade.

POLITICAL conditions are regarded by the majority of business interests as the greatest factor retarding the rapid growth of business at this time. The prolonged agitation over tariff revision has been and continues to be a source of widespread uncertainty, and the great number of investigations originating in the House have restricted application of the future policy of many of the great industries of the country. The general trend of feeling toward these influences has become more sanguine in the past few weeks, but there is every reason to believe that news of a resolution offered this week for adjournment of Congress on Aug. 22 was received with satisfaction in many industrial quarters. In the week just past many evidences of increasing confidence were shown and trade exhibited further signs of expansion. Buyers are appearing more freely in the various markets, and the volume of sales is increasing, although a large degree of conservatism still prevails. Building operations for July are reported as 14 per cent in excess of those for July, 1910, and the recent statement of unfilled orders on the books of the Steel Corporation showed an increase of 233,000 tons over the total reported for the period ended June 30. Mills are now operating on a larger percentage of capacity than has been the case in recent weeks and while a considerable portion of the activity is due to the placing of delayed orders for fall delivery, good business for the remainder of the year seems assured. Sentiment is improved by reports of further decrease in the number of idle cars. The government report on crops issued last week, while depicting unfavorable conditions, was not regarded seriously and better yields are expected than forecasted in the government's review. Weather conditions have been beneficial in the last few weeks and rain has fallen in many districts that were in need of moisture. Opinion in general is inclined to believe that trade has passed the critical stage and that steady advancement is assured. Business failures for the week ended Aug. 10 as reported by *Bradstreet's* were 208, as compared with 208 for last week, 231 for the same week in 1910, 219 in 1909, 249 in 1908 and 146 in 1907.

The Copper Market.

CONTRARY to expectations, no impetus was given to the buying movement by the favorable report of the Copper Producers' Association, and, aside from a small increase in the number of inquiries, the situation is unimproved. Producers are decidedly disturbed by the lack of response to the report and their only sources of encouragement are the continuation of foreign demand and the belief that stocks in consuming hands are low, as a consequence of prolonged absence from the market for large amounts. Consumers abroad have taken advantage of the low prices of the past few months and have purchased liberally and these foreign sales, as mentioned in previous issues, have been the sustaining element of the copper market. Inasmuch as the recent statement of the Copper Producers' Association showed an increase of over 250,000 lb. in the visible supply of copper abroad, it now looks as if foreign demand is approaching repletion and as if a lighter demand is imminent. Should this be correct, the shortage of copper and higher prices, recently predicted by the president of the Amalgamated Company, are remote and it is more probable, from present indications, that unless the policy of curtailment is maintained the outcome will be lower prices in order to move the supplies at the mines. On the other hand there is a likelihood that the hope of the producers for early increase in domestic demand will materialize to a mild degree and this should nearly offset a temporary lull in business from abroad. Exports for the month, including August 15, were 11,656 tons. The daily call on the Metal Exchange, August 15, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.17½	12.37½	.....
August	12.20	12.37½	12.30
September	12.20	12.37½	12.30
October	12.20	12.37½	12.30
November	12.20	12.37½	12.30

The London market, August 15, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	56 10 0	56 7 6
Standard copper futures	57 5 0	57 2 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.35c	11.57½c
London, spot	£57 10 0	£53 7 6
London, futures	58 2 6	54 0 0
Best selected	61 10 0	57 5 0

Industrial and Commercial Notes.

Electrical Equipment for New York's Fifty-five-story Building.—Bids on elevators, generators, engines and other mechanical apparatus for the Woolworth building, now in course of erection at Broadway, Park Place and Barclay Street, New York City, are invited by the Thompson-Starrett Company, general contractors on the work. Specifications for this equipment were drawn by Messrs. Mailloux & Knox, designers of the electrical installation in the Metropolitan Life Insurance building and the Municipal Offices building in New York. There are to be twenty-nine elevators and the cars of the main group are to carry 2,500 lb. at a rate of 700 ft. per minute. Bids are requested on three wire generators as follows: (a) one 200-kw unit, (b) one 300-kw unit and (c) two 500--kw units, all at speeds of 100 r.p.m., for coupling direct to engines. The commercial efficiency at full load, three-quarter load and half load is to be not less, respectively, than the following: For the 200-kw unit 91, 91 and 89 per cent; for the 300-kw unit, 92, 92 and 91 per cent, and for the 500-kw units, 92.5, 92.5 and 91.5 per cent. Alternate estimates may be offered, first on three wire generators to have speeds of 150 r.p.m. for the 200-kw and 300-kw units, and 120 r.p.m. for the 500-kw units, and also on two wire machines with balancer sets. Specifications for the engines call for either four-valve Corliss engines with releasing valve gear or four-valve engines with non-releasing valve gear, and alternate estimates are invited on both simple and compound engines of both types.

New Electric Company in Maine.—The Bangor Power Company has been incorporated at Portland, Maine, the incorporation certificate, however, stating the company to be located at Bangor, Maine. The authorized capital stock is $1,250,000, all common stock, and the purpose is stated to be the acquisition and operation of the property formerly held by the Bodwell Water Power Company, and the rights and franchises of the same company in the cities and towns of Bangor, Brewer, Oldtown, Bradley, Eddington, Hamden, Milford, Orono and Veazie, and such rights, property and franchises as may be acquired elsewhere in Penobscot County. The property listed in this incorporation certificate is the same as that which was recently purchased by John R. Graham, president of the Bangor Railway & Electric Company and of the Lewiston, Augusta & Waterville Street Railway. The incorporators named in the certificate are Clifford E. McGlauflin, president; E. M. Mitchell, treasurer; and H. M. Verrill, clerk; all of Portland, Maine, the three officers constituting the board of directors.

Sale of Brooklyn Telegraph Company in Abeyance.—With further reference to advices that F. M. Delano of Detroit, has secured an option of four-fifths of the stock of the American District Telegraph Company of Brooklyn, as mentioned in these columns July 1, Henry W. Kilbourne, secretary and treasurer of the company, said this week that no changes have developed in the situation and that negotiations will probably be deferred until fall. Its charter covers both telegraph and telephone service and it is understood that the Western interests seeking control of the company will use this provision of the charter to establish telephone competition in Brooklyn. Mr. Kilbourne said he did not know the nature of the plans under consideration by the Detroit interests.

To Manufacture New Battery.—The Efficiency Electric Company, 4524 Lincoln Avenue, Chicago, has been formed to manufacture a new type of dry battery invented by Ralph G. Carpenter and Charles G. Johnson. It is claimed to be the only 2-volt dry-cell made and capable of easy renewal.

Westinghouse Railway Orders.—Among orders recently received for Westinghouse railway apparatus are the following: From the St. Joseph, Mo., Railway, Light, Heat & Power Company for a partial equipment of interpole railway motors; from Denver & Inter-Mountain Railway Company, for quadruple equipments of interpole railway motors, with control; Hutchinson, Kan., Interurban Railway Company, for a double equipment of railway motors, with control; from Ford, Bacon & Davis interests for the Birmingham, Ala., Railway, Light & Power Company, for a 1000-kw, 60-cycle, self-starting rotary converter with the usual accompaniment of transformers, switchboards, blowers, etc.; Capitol Traction Company of Washington, D. C., for two complete sub-station equipments, one covering a 1500-kw, 25-cycle self-starting rotary converter with the necessary transformers and switchboards, and the other a 1000-kw, 25-cycle self-starting rotary converter with switchboards and transformers; Chicago Railways Company for equipment for the extension of its La Salle Street sub-station, including two 3000-kw, 25-cycle self-starting rotary converters, with the necessary transformers, and a 10-panel switchboard; Dakota Power Company of Rapid City, S. D., for three 500-kw waterwheel generators, three 500-kw, 24,000-volt water-cooled transformers, three 200-kw, 24,000-volt self-cooled transformers of 24,000 volts, and a large switchboard; Georgia Railway & Electric Company of Atlanta, for a 1000-kw, 60-cycle self-starting rotary converter with transformers and switching apparatus; Interurban Railway Company of Des Moines, Ia., for a 300-kw, railway rotary converter, self-starting, together with the necessary transformers and switching apparatus; Kokomo, Ind., Public Utility Company, for a 1500-kw turbo-generator unit, 500-kw self-starting rotary converter and the necessary transformers and switching apparatus; Metropolitan Street Railway of Kansas City, Mo., for a 3000-kw, 25-cycle, self-starting rotary converter with three 11,000-kw air-blast transformers and the necessary switching and blower apparatus; Olympic Power Company of Port Angeles, Wash., for two 3000-kw waterwheel generators, seven 1000-kw 38,200-volt water-cooled transformers, with the usual exciters and a large switchboard.

Keystone Electrical Instrument Company Change in Management.—A change is announced in the management of the Keystone Electrical Instrument Company of Philadelphia, Richard P. Brown becoming president of the company, and J. Franklin Stevens resigning. J. W. W. Cornman, the former secretary, will continue in that capacity and Mr. Stevens' advice and interest will still be with the company. Richard P. Brown has for a number of years been president of the Brown Instrument Company of Philadelphia, established in 1860, the oldest concern in the United States manufacturing pyrometers, and which has had wide experience in the design and manufacture of scientific instruments. The voltmeters and ammeters manufactured by the Keystone Electrical Instrument Company have always been designed in a manner to meet particularly general industrial service, and under the suggestions of Mr. Brown slight changes in construction have been made which will particularly recommend themselves to engineers. By this arrangement the Brown Instrument Company and the Keystone Electrical Instrument Company will manufacture pyrometers, thermometers, speed indicators, draft gages, recording gages, voltmeters and ammeters. In fact, the company is now in a position to manufacture or repair practically any type of instrument. In addition to the works and office at 9th Street and Montgomery Avenue, Philadelphia, an office will also be maintained for the present at 311 Walnut Street, and the branch offices of the Brown Instrument Company at Pittsburgh and Chicago will now also handle Keystone instruments.

Foreign Trade Opportunities.—Schedule 7181, on file at the Bureau of Manufactures, Washington, D. C., states that an American consul in Asia has forwarded the name of a person in his district who wishes to obtain prices f.o.b. Seattle, Wash., with gross and net shipping weights, on the following electrical machinery: 250-kw, 60-cycle, three-phase, 2000-volt generator; 100-hp, 60-cycle, three-phase, 1000-volt motor; 75-hp, 60-cycle, three-phase, 1000-volt motor; 250-kw air-cooled step-up transformer, 2000 to 10,000 volts; 250-kw, air-cooled step-down transformer, 10,000 to 1000 volts; 10-kw, air-cooled step-down transformer, 1000 to 110 volts; 20-kw, air-cooled step-down transformer, 1000 to 110 volts; 350-hp turbine to operate under a 50-ft. head; a 10-in. centrifugal pump to work under a 40-ft. head, and a 6-in., three-stage centrifugal pump for raising water 200 ft. Instruments, switchboard, etc., will be required.

Water Supply for Ohio Hydroelectric Company.—The Auglaize Power Company, of Toledo, Ohio, through its president, James M. Ashley, has secured a twenty-five-year renewal of its contract with the State for water-power from the Grand and Laramie reservoirs, at the rate of $4,000 per year. In addition to this payment the company is to maintain the two reservoirs and keep them in order. They were constructed seventy-five years ago to supply water for the canals in that part of the State. Waste water from the reservoirs will be used during the low-water periods to increase the supply for the hydroelectric plant that is being constructed on the Auglaize River, 3 miles above Defiance. The company will expend $100,000 in establishing facilities for collection, storage and transportation of water during the dry-weather periods.

Changes in Toronto Electric Light Directorate.—At the first meeting of the Toronto Electric Light Company since control was acquired by Mackenzie interests, as mentioned in a recent issue, a number of changes were made in officers and directors. The new directors of the company are: Sir William Mackenzie, Robert J. Fleming, manager Toronto Street Railway Company, D. B. Hanna, Z. A. Lash, general counsel Canadian Northern R. R.; E. R. Wood, H. H. Macrae, R. C. Brown and G. A. Morrow. Sir Henry Pellatt retains the office of president, while W. D. Matthews was succeeded as vice-president by D. B. Hanna, third vice-president of the Canadian Northern R. R. H. H. Macrae gave up the general managership of the company and became second vice-president.

Sale of Sioux Falls Light & Power Company.—H. M. Byllesby & Company, through their principal office at Chicago, confirm the reported purchase of the Sioux Falls Light & Power Company of Sioux Falls, S. D. This company owns and operates a hydroelectric station on the Big Sioux River, reinforced by a modern steam auxiliary plant, and serves the greater part of Sioux Falls with current for lighting, transportation and power. Formal possession will be taken in a few days, with N. C. Draper, formerly of Zanesville, Ohio, as manager. Improvements and extensions will be made to the property. The Bennett Light & Power Company at Sioux Falls has been sold to Frank Thompson of St. Paul.

W. S. Barstow & Company, Inc., Plan Appliance Demonstrations.—The success of the gas appliance campaign conducted earlier in the year by W. S. Barstow & Co., Inc., at their various gas companies has led to plans for a series of similar demonstrations of electric appliances at the electric companies. F. Lewis White, of the Barstow company, who had charge of the gas appliance campaign, will have charge, and will spend at least one week at each of the companies. Demonstrations will be given nearly all classes of appliances, and where prospects warrant it, the exhibit will be continued longer than a week.

New Colorado Power Company.—The Trinidad Transmission Railway & Gas Company has been incorporated with an authorized capital of $4,000,000, the incorporators being Messrs. C. H. Williams, R. H. Widdecamp, John M. Gates, C. W. Collins and A. S. Brooks. The company recently took over the Colorado Railway, Light & Power Company, as noted last week, and will begin operations in Las Animas, Heurfano, Pueblo, Fremont and Denver Counties.

Toledo & Ohio Central Railroad to Install Its First Telephone Train-Dispatching Circuits.—The Western Electric Company has received an order from the Toledo & Ohio Central Railroad for forty-eight telephone selector equipments for use on the eastern division of the road. Two circuits will be equipped, one extending from Bucyrus to Toledo, a distance of 70 miles, and the other from Bucyrus to Thurston, a distance of 78 miles.

Turbo-Generator for Evansville, Ind.—The Westinghouse Machine Company has received an order from the Evansville, Ind., Gas & Electric Company for a 1600-kw turbine of the improved high-speed, double-flow type. The electrical end of the unit comprises a Westinghouse generator normally rated at 2000-kva, delivering 3-phase, 60-cycle currents at 2300 volts.

Aluminum Notes and Prices.—The aluminum market as of August 15 is reported steady, with ingots for remelting held at 20@20½ cents spot No. 1, the base for large ingots. Rods and wire are quoted at 31 cents, and sheets at 33 cents.

Financial.

The Week in Wall Street.

DECLINES were made in the majority of active issues in the latter part of the previous week, and in many cases prices nearly reached the lowest figures of the year. The chief cause of the activity was the unfavorable grain report issued by the government, and other matters lending their influence to the downward movement were the continuation of investigations and rumors of heavy liquidation of large holdings. Thursday's transactions reached a million shares. Railroad issues were traded more extensively than other securities on the list and experienced the heaviest declines. Recovery took place in Monday's market and nearly all stocks gained a point over Saturday's prices. Foreign buying was on a larger scale and higher prices were made in international stocks, assisting the trend of the local market. Trading was irregular throughout the day and after a period of dullness in the afternoon advances were made at the close and the highest prices for the day were made at that time. Weakness in the wheat markets reflected news of better conditions from the crop centers. The market on Tuesday was irregular, and Monday's recovery was not advanced, several important issues suffering further decline. United States Steel was the only issue on which a gain was registered and in this case the advance was small. The tone of the market was discouraging to many, not from a standpoint of prices alone, but by reason of the check given to the advance of an outside buying movement. The most encouraging news on Tuesday was the government's weekly report on crop conditions. Both corn and wheat have been improved by the good weather that has prevailed and strong hopes are entertained for yields better than indicated by the August report. The bond market is unsettled as a result of conditions in the stock market. Demand is light, but the prospects for early increase are regarded as good. The money market is hardening slightly with harvesting plans. Rates August 15 were: Call, 2¼@2½ per cent; ninety days, 3¼@3½ per cent. The quotations in the tables are those at the close, August 15.

NEW YORK

	Aug. 8.	Aug. 15.	Shares Sold.		Aug. 8.	Aug. 15.	Shares Sold.
All. Ch.....	6¼*	6¾*	100	Int. Met., pf.	45½	43¼	8,725
All. Ch., pf..	22¾	20	900	Mackay Cos..	85⅛	83	700
Amal. Cop...	64¼	62	79,010	Mackay C.,pf.	74½*	72*	400
Am. D. T....	20½*	20½*	———	Man. Elev...	137½*	135*	400
Am. Loco...	38	37*	2,850	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	106*	107½	200	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	79¾*	79¾*	———	Steel, com...	74⅞	73¾	1,009,110
Am. T. & T.	135⅞	134⅝	10,370	Steel, pfd....	116⅞	115¾	8,830
B. R. T.....	76⅞	75¾	25,100	W. U. T.....	76½	74½	5,900
Gen. Elec....	155	154½	7,750	West'h, com.	66	65½	6,200
Int. Met.....	16⅞	15½	3,100	West'h, pfd..	118¼*	118¼*	———

PHILADELPHIA.

	Aug. 8.	Aug. 15.		Aug. 8.	Aug. 15.
Am. Rys.....	44½	44½*	Phila. R. T.....	23½	23
El. Co. of A.....	11⅜	11⅞	Phila. Elec.....	17¾	17⅝
Elec. St. Bt'y.....	53	52⅜	Phila. Trac.....	85½	86*
Elec. St. Bt'y., pf..	30*	30*	Union Trac.....	51⅜	51

CHICAGO.

	Aug. 8.	Aug. 15.		Aug. 8.	Aug. 15.
Chi. City Ry.....	186*	186*	Com. Edison.....	134	132
Chi. Elev. Rys.....	26½*	25*	Chi. Subways.....	3⅛	2¾*
Chi. Elev. Rys.....	93*	93*	Chi. Tel Co.....	123*	123*
Chi. Rs., Ser. 1....	95	95*	Nat'l Car.....	111	110½*
Chi. Rs., Ser. 2....	30¾	30	Nat'l Car, pfd.....	118½*	118½*

BOSTON.

	Aug. 8.	Aug. 15.		Aug. 8.	Aug. 15.
Am. T. & T.....	135	134½	Mex. Tel.....	4*	4¼*
Cum. Tel.....	157½*	156	Mex. Tel., pfd.....	6*	6*
Edison E. Ill.....	286	286½	N. E. Tel.....	148½	147½*
Gen. Elec.....	155¼	153½	W. T. & T.....	19	18¼
Mass. E. Ry.....	20¾	19¾*	W. T. & T., pfd....	99*	96½*
Mass. E. Ry., pf....	92½*	91			

*Last price quoted.
Shares sold for the week, Aug. 7 to Aug. 12.

Financial Notes.

Denver City Tramway Bonds Offered.—Russell, Brewster & Company, of Chicago and New York, are offering first and refunding sinking fund mortgage twenty-five-year 5 per cent gold bonds of the Denver City Tramway Company dated November 1, 1908, and due November, 1933, at 95 and interest to yield about 5⅜ per cent. The company was incorporated in 1899 and operates the entire street railway system of Denver, consisting of 223 miles of track, and the bonds are secured by direct mortgage on 197 miles of track within the city limits. The authorized issue is $25,000,000, of which $4,720,000 is outstanding. Of the balance $10,911,800 are reserved to retire all other bonds of the system, and $9,368,200 are for additions and permanent improvements under carefully guarded restrictions. The bonds are callable as a whole, but not in part, except for sinking fund, at 105 and interest, on any interest period from and including May 1, 1914, to and including November 1, 1923, and thereafter at 102½ and interest, upon sixty days' notice. The franchises of the company are without time limit, and in 1907 were held by the United States Circuit Court to be valid at least until 1935, two years beyond the life of these bonds. Gross earnings of the company for the year ended December 31, 1910, were $3,595,158, and operating expenses were $1,859,251, leaving net earnings of $1,735,907. After deducting all charges, excepting interest on these bonds, there was left a balance of $829,754, which represents more than three and one-half the interest requirement on the bonds outstanding.

Keystone Telephone Earnings.—In the twelve months ended June 30 the revenues of the Keystone Telephone Company were the largest in the history of the company. Gross earnings were $1,153,788, as compared with $1,126,030 in 1910, and net earnings were $581,784, as compared with $567,952 for the previous period. Interest charges showed a decrease, being $293,383, as against $302,775, and the surplus available for dividends increased from $265,177 in 1910 to $288,401 in the last fiscal period. Each of the statements in the past five years has been an improvement on the one preceding it and interests associated with the company regard the prospects as favorable for continuation of this record. Announcement is made that the proceeds of the $300,000 two-year 5 per cent notes sold to Dick Bros. & Company by the Keystone Telephone Company will be used for extensions and betterments within the next two years. These improvements are in addition to those for which provision was made in the regular annual appropriation. It is not known at this time whether these notes will be refunded at a later date into a more permanent form of capital, but it is believed from the present rate of earnings that the company should be in a position to take them up from earnings.

Western Electric Business.—Although gross sales of the Western Electric Company for the month of July were 3 per cent less than in July, 1910, and it is unlikely that the company will earn the $71,000,000 expected from the scale of business in the earlier part of the year, gross sales for the seven months of the current year are 4 per cent in excess of those in the corresponding period of 1910. The present rate of business indicates a total of $66,000,000 for the year, approaching closely the record of 1906, when gross totaled $69,000,000. Reports from the various territories show that July sales in the east were nearly equal to those in July, 1910, and that the falling off in the month was in the central and western territories. Attention is called to the decrease in the average amount of each order with increase in the size of the company and in the number of customers. Whereas in 1910 the average of orders was $72, showing a decrease as compared with previous years, the average for the present year is approximately $70. It is stated that 26,000 persons are now employed by the company, as against 29,000 in 1906. Foreign business is reported satisfactory and the record of all departments is regarded as favorable in view of the dullness in general trade.

Boston Edison Makes Excellent Financial Showing.—A forecast of the annual report of the Edison Electric Illuminating Company of Boston, to be issued early in the fall, indicates that the company has made the best showing of any year in its history. Gross earnings for the fiscal year ended June 30, 1911, as already made public, amounted to $5,257,913, an increase of $548,457, or 11.65 per cent over the year preceding. It is expected that the report will show net earnings available for dividends of over $2,300,000, equivalent to 14.7 per cent, on the 156,037 shares outstanding, and an increase of about $300,000 over a year ago. Increase in the amount of dividends paid during the past year, due partly to the new issue of stock and partly to the 12 per cent rate, will about absorb this $300,000 increase.

Cities Service Earnings.—The report of the Cities Service Company, for ten months ended July 31 gives earnings on stocks of subsidiary companies as $718,219. Other income was $32,863, and gross earnnings were $751,082. Expenses were $23,299, leaving net earnings of $727,783. Dividends on preferred stock were $413,956, leaving a balance of $313,827 available for dividends for common stock. Dividends on the common stock amounted to $118,650, after payment of which a surplus of $195,177 remained.

San Joaquin Light & Power Corporation.—N. W. Halsey & Company are offering the unsold balance of $1,000,000 first and refunding 5 per cent sinking fund gold bonds of the San Joaquin Light & Power Corporation at 93 and accrued interest, to yield 5.43 per cent. These are dated 1910 and are due in 1950. Net earnings in the past year were more than three times all bond interest. A letter of W. G. Kerckhoff, president of the company, says in part that the outstanding bonds of the company, including those now offered, have been issued for the completion of a massive dam at the outlet of Crane Valley, on the San Joaquin River, which has increased the capacity of the Crane Valley reservoir to 51,000 acre-feet, thus providing ample water to operate the company's hydraulic plants to their full capacity during the entire season, with a large amount in reserve; for the completion of the new San Joaquin powerhouse, having a capacity of 21,400 hp; for the erection of a steam turbine plant at Bakersfield, Cal., with a capacity of 10,667 hp; for the completion of a high-voltage transmission line connecting all the properties; double-tracking and otherwise improving the Bakersfield Electric Railway; and for making other betterments which will largely increase the earning power of the corporation.

Allis-Chalmers Earnings.—While the annual report of the Allis-Chalmers Company for the fiscal year ended June 30 will not be made public until October, it is thought that a considerable decrease will be shown in both gross and net earnings as compared with those for the preceding year. Interests associated with the affairs of the company are quoted, however, as saying that there is little doubt that interest requirements will be earned, and that there will be a small margin over all charges. It is further stated that the policy of the directors in making monthly appropriations from net earnings to depreciation accounts has been enforced throughout the year, and that in all probability the total appropriation will equal that of the year preceding. Reports of current earnings show improvement and it is estimated that the plants of the company are now operating between 50 per cent and 60 per cent of capacity. Business, however, is reported as irregular, orders from some sections of the country being nearly upon a maximum scale, while in others a falling off is noted.

Mountain States Telephone Company.—The $6,500,000 indebtedness of the Rocky Mountain Bell Telephone Company, mentioned in the issue of July 29, which gave an account of sale of the company to the newly formed Mountain States Telephone Company, will be assumed by the latter. The Mountain States Company will give 14,217 shares of its stock in exchange for 23,695 shares of Rocky Mountain Bell Telephone stock, and will also pay dividends at the rate of 7 per cent, dating from July 20, in case the transaction is consummated, and the stock is exchanged on or before September 30, 1911. President Lane of the Rocky Mountain Company says, in a statement to stockholders, in reference to a meeting scheduled for August 17 to confirm the sale of the company, that this transaction is only a step in the plan which directors have been considering for grouping all telephone properties in the Rocky Mountains under one management and ownership.

Federal Receiver Appointed for Winona Railway, Light & Power Company.—In connection with the passing of interest due July 1 on $495,500 bonds of the Winona Railway, Light & Power Company, of Winona, Wis., mentioned in these columns July 29, it is learned that Howard Norris of Milwaukee has been appointed receiver for the company by the United States District Court. A cash tender of $12,735 for payment of the defaulted interest to the Old Colony Trust Company of Boston, trustee for the bondholders, was offered by C. C. Smith for the receivers as a plea against appointment. Objection to the tender was made by attorneys for the trust company on the ground that the tender was not offered in good faith.

United Wireless System to Be Maintained.—Selden Bacon, who was recently appointed receiver in bankruptcy of the United Wireless Company by the United States Circuit Court for the District of Maine, states that all the stations of the company will be maintained and kept in active operation. Mr. Bacon starts shortly upon an extended trip through various sections of the country embraced by the stations of the company. It is stated that although many operators of the United Wireless Company at shore stations on Lake Michigan have not received regular salaries since June, all are at their keys to protect shipping and passengers from disaster, but that none will accept commercial business.

Toronto Street Railway Stock Increase Ratified.—At a special meeting held August 14, stockholders of the Toronto Street Railway Company accepted the plan to increase the capital stock from $8,000,000 to $12,000,000. It was announced that the additional capital will be disposed of as follows: Two millions at par are to be issued to stockholders, $1,000,000 is to remain in the treasury, and $1,000,000 is to be divided among stockholders as a stock dividend. This distribution applies to stockholders of record August 25. It was further explained that the additional capital will be used in improving the system.

Receiver for La Crosse Water-Power Company.—Upon petition of a bondholders' committee, a receiver has been appointed for the La Crosse Water Power Company, of La Crosse, Wis. The receiver, Clement C. Smith, of Milwaukee, at once appointed Mr. W. J. Ferris, president of the company, as general manager. The financial difficulty of the company was due to shortage of water in reservoirs during the past two years, which small rainfall has been without precedent, as mentioned in these columns March 30. Plans for increased storage capacity were made, and it is expected that work on these will now proceed.

Plan to Retire Northwestern Elevated Bonds.—Advices from Chicago state that the Northwestern Elevated Railroad Company will retire the $18,000,000 first mortgage bonds which mature September 1. The trustees of the Northwestern Elevated will meet next Monday and formally authorize a new first mortgage of $25,000,000 on all the company's property. This mortgage must be held as part of the collateral security of the Chicago Elevated Railway's issue of $30,000,000 5 per cent three-year notes.

Foreign Interests to Promote Electric Industry.—Announcement is made that a number of European contractors, financiers, and electrical engineers have formed an association known as the Griffiths Electric Contractors, Ltd., to finance design, contract and operate electrical works in various countries of the world. J. Norton Griffiths, E. P. Powles, R. D. McCarter, and J. Kerr Bock are named as members of the London board of management. It is stated that a number of leading French firms are also interested.

Winnipeg Electric Railway Matters.—Negotiations are still in progress between Sir William Mackenzie, president of the Winnipeg Electric Railway Company, and a special committee of the city council for arranging a sale of all the interests of the company in Winnipeg on a basis of $24,000,000.

Omaha Company Increases Stock.—The authorized capital stock of the Omaha Electric Light & Power Company has been increased from $2,500,000 to $4,000,000 by the addition of $1,500,000 common stock. Preferred stock is now $1,000,000 and common stock $3,000,000.

DIVIDENDS.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable Oct. 1.

Cities Service Company, monthly, preferred, one-half of 1 per cent; common, one-quarter of 1 per cent; both payable Sept. 1.

Northern Texas Electric Company, semi-annual, preferred, $3.00 per share; common, quarterly, $1.50 per share; both payable Sept. 1.

St. Joseph Railway, Light, Heat & Power Company, quarterly, one-half of 1 per cent, payable Sept. 1.

Terre Haute Traction & Light Company, preferred, 3 per cent, payable Aug. 21.

REPORT OF EARNINGS.

LAKE SHORE ELECTRIC RAILWAY COMPANY.

Period.			Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
June,		1911	$113,950	$58,182	$55,768	$34,604	$21,163
"		1910	103,533	52,244	51,289	34,751	16,537
6m.,	June,	'11	558,585	313,129	245,457	208,003	37,454
"	"	'10	526,727	298,697	228,030	208,601	19,420

NIAGARA, LOCKPORT & ONTARIO POWER COMPANY.

6m.,	June,	'11	$270,859	$87,587	$181,187	$125,000	$56,187
"	"	'10	247,283	84,564	155,521	125,000	30,521

ONTARIO POWER COMPANY.

3m.,	June,	'11	$202,895	$37,610	$186,729	$167,536	$19,192
"	"	'10	170,374	33,192	151,916	137,747	14,168

General News

Construction News.

TUCSON, ARIZ.—It is reported that H. A. Smith, of this city, has perfected plans for the installation of a large electric power and irrigation system near Noria, Sonora, Mex., which, in addition to supplying electrical energy for the operation of four mines and smelters, will furnish electricity for lighting the town of Llano and water for the irrigation of about 15,000 acres of land. A reservoir site near Noria has been selected, and engineers are at work on the project.

ESCONDIDO, CAL.—The City Trustees have granted to the Escondido Utilities Company a sixty-day extension of time, from Aug. 1, in which to install the additional street lamps which will increase the lighting facilities of the city about 40 per cent. The urgent demand for connections from circuits already installed is responsible for this delay.

FALLON, CAL.—An application has been filed by the citizens of Fallon for the right to utilize the surplus electrical energy from the transmission line which the government proposes to construct from the La Hontam dam.

FRESNO, CAL.—The Fresno, Hanford & Summit Lake Railway has applied to the Board of City Trustees for a franchise to construct an electric railway over I and Tuolumne Streets in Fresno.

LOS ANGELES, CAL.—The city of Los Angeles has entered into a contract with the Southern California Edison Company to light the streets at the harbor (San Pedro) with arc lamps at $5 per month, the same as the former contract. Provision is made for the termination of the contract any time after Jan. 1, 1913.

RIVERSIDE, CAL.—The Board of Public Utilities, Riverside, Cal., has ordered the lowering of the lighting rate from 9 cents to 7 cents per kw-hour; for cooking and heating, 3 cents, and power from 6 cents to 4 cents at the municipal plant.

SACRAMENTO, CAL.—An electric-lighting system is to be installed in Capitol Park. It is planned to have twenty lamps on standards in the outer portion of the park, sixty lamps along the walks about the building and twelve lamps on the Capitol dome, the wires being placed in conduits. The estimated cost of the system is $13,000.

SAN JOSE, CAL.—The Peninsula Railway Company has applied to the City Council for permission to construct an electric railway in Alum Rock Park.

TULARE, CAL.—The Tulare Power Company, which was recently organized for the purpose of developing electrical energy for use in Tulare County, and incidentally to furnish service for the new Holly electric railway, will commence at once the construction of the auxiliary plant which it proposes to establish at Tulare, the work to be in charge of former City Electrician W. E. Caffrey, of Reno. A site has been secured near the eastern limits of the city on the Truckee River, at which point it is expected that about 5000 hp can be developed. The directors of the new company are Fred Billings, of Tulare; Mr. Smith, of Strathmore; Messrs. Brisco and McQuerry, of Lindsay, and C. H. Holly, of Porterville.

CANON CITY, COLO.—A special meeting was held recently in this city to consider a proposition of New York capitalists to construct an electric line to the top of the Royal Gorge, the estimated cost of such construction being $230,000. A guarantee of 6 per cent on the investment was asked.

NEW HAVEN, CONN.—The Board of Aldermen has voted to grant Yale University the privilege of installing conduits in certain streets, for the accommodation of the new Yale buildings erected on Pierson-Sage Square. It is estimated that the conduit system will represent an expenditure of $250,000, and the heating plant proper to be located on Pierson-Sage Square another $250,000, making a total expenditure of $500,000 for this central-lighting plant.

NEW MILFORD, CONN.—It is expected that the New Milford Electric Light Company will extend its transmission lines to Bridgewater and Kent at an early date, application for service in these towns having been made.

SAYBROOK, CONN.—The Shore Line Electric Railway Company is seeking an amended charter giving it power to generate and transmit electrical energy in several shore towns. The company will also furnish the energy required for operating the new drawbridge at Old Saybrook.

SOUTH MANCHESTER, CONN.—The South Manchester Light, Power & Tramway Company, which recently took over the North End lighting equipment, is planning to improve that portion of its system by considerable new construction, and by increasing the emf at North End from 1200 volts to 2400 volts. It is also the company's intention to extend its transmission lines to Talcottville and Buckland.

SOUTH NORWALK, CONN.—The Housatonic Power Company has recently acquired possession of the Westport Water Company, which furnishes a lighting service in Westport, Saugatuck and Greens Farms. The deal involves the transfer of the permanent charter to furnish Westport with water and electricity, the riparian rights held by the company and its up-to-date plant and property. While no definite statement has been made, it is generally believed that the Housatonic company will dispense with the electrical portion of the Westport plant, supplying energy from its own power stations.

WINSTED, CONN.—The lighting committee of the Board of Wardens has under consideration the installation of a modern system of street lighting in Winsted, recommendations for such a system having been submitted by A. C. Winchester, consulting engineer, of South Norwalk, and W. W. Young, of New York.

WASHINGTON, D. C.—A bill has been introduced by Senator Myers authorizing the Conrad-Stanford Company to erect a power plant and stamp mill on the banks of the Yellowstone River in the Yellowstone National Park, for the purpose of operating the Crevasse mining claims. It is also the intention of the Conrad company to construct a transmission line from the power plant to the mine.

WASHINGTON, D. C.—Schedule 7181, on file at the Bureau of Manufactures, Washington, D. C., states that an American consul in Asia has forwarded the name of a person in his district who wishes to obtain prices f.o.b. Seattle, Wash., with gross and net shipping weights, on the following electrical machinery: 250-kw, 60-cycle, three phase, 2000-volt generator; 100-hp, 60-cycle, three phase, 1000-volt motor; 75-hp, 60-cycle, three phase, 1000-volt motor; 250-kw, air-cooled step-up transformer, 2000 to 10,000 volts; 250-kw, air-cooled step-down transformer, 10,000 to 1000 volts; 10-kw, air-cooled step-down transformer, 1000 to 110 volts; 20-kw, air-cooled step-down transformer, 1000 to 110 volts; 350-hp turbine, to operate with a 50-ft. head; a 10-in. centrifugal pump, to work under a 40-ft. head; and a 6-in., three-stage centrifugal pump for raising water 200 ft. Instruments, switchboard, etc., will be required.

JACKSONVILLE, FLA.—Bids will be received by the Board of Bond Trustees until Sept. 4 for the removal of certain machinery from the old electric-light plant to the new power station now being constructed near Tallegrand, and for building the superstructure of the new plant.

ALBANY, GA.—The Albany (Ga.) Transit Company has been incorporated to construct an electric railway in the city and suburban districts of Albany. The company has an authorized capital stock of $75,000, and the incorporators are: C. W. Rawson, S. B. Brown, F. F. Putney, W. W. Page and J. A. Davis, all of Albany.

DALTON, GA.—Application for a 30-year franchise in this city has been made by the Georgia Power Company, of Gainesville, Ga. If it is granted, it is expected that the work of extending the company's transmission lines to Dalton will be commenced at an early date.

MAYSVILLE, GA.—Advices have been received from J. M. Gillespie, City Clerk, that no definite action has yet been taken for the construction of a water-works and electric-light plant.

LEWISTON, IDAHO.—The Nez Perce Water Power Company, which furnishes a lighting service in Nez Perce and is also interested in hydro-electric developments in northern Idaho, contemplates the extension of its transmission lines to the Lewiston district. The company recently passed into the hands of Messrs. Welch & Montague, of Portland.

STITES, IDAHO.—The City Councilmen have decided to construct a dam and electric power plant near Stites, which will furnish a lighting service in that city, as well as energy for operating the pumps at the proposed municipal water works. The installation will cost in the neighborhood of $3,000.

DEKALB, ILL.—An ornamental street-lighting system will probably be installed in DeKalb at an early date, the City Council having the matter under consideration.

FAIRBURY, ILL.—A contract has been awarded by the Fairbury Electric Light Company for a new 300-hp boiler.

MONMOUTH, ILL.—It is the intention of the Western Stoneware Company to electrify its plant No. 1 at this city, the contract having been awarded to the Monmouth Public Service Company, which installed the electrical equipment in its plant No. 2.

PEORIA, ILL.—A new ornamental street-lighting system is to be installed in this city; a committee, consisting of Messrs. Spurck, O'Neill, McDowell, Rehfuss and T. O. Grimm, having been appointed by the Main Street Ornamental Lighting Association to select the proper standards, advertise for bids and proceed immediately with the installation.

SPRINGFIELD, ILL.—The organization of the Springfield & Northwestern Interurban Railway Company, which proposes to construct an electric line from Springfield to Petersburg, passing through Andrew, Cantrall, Athens, Tice and Old Salem, has been perfected. The company will have a capital stock of $15,000, and the following directors have been named: Homer J. Tice, Greenview; R. Y. Kincaid, Athens; E. D. Keys, W. F. Workman, Ralph N. Baker, Frank Reisch, Jr., and S. E. Prather, Springfield.

BEDFORD, IND.—The merchants of the Industrial Association, of Bedford, are perfecting plans for the installation of a new ornamental system of street lighting throughout the business district. The five-cluster type of lamp will be employed, placed on iron and steel standards 13 ft. high.

CONNERSVILLE, IND.—It is stated that the installation of the new electric-light and power plant at this city, in which E. Dwight Johnston is largely interested, will be commenced at once, the contract for the construction of the buildings and the necessary concrete work having been placed with Greenwood & Conner. The plant will enter the local field in competition with the existing plants.

CRAWFORDSVILLE, IND.—The trustees of the municipal electric-light plant have established a minimum charge of 50 cents per month. This charge, even though no energy is used, is made necessary, the trustees state, in order to cover the depreciation of transformers, meters and service wires, and the constant loss of energy that is consumed by the transformers. Apparently there has been no opposition to the minimum rate.

KENDALLVILLE, IND.—For some time the City Council has had under consideration the matter of furnishing the city with a more adequate lighting service, either from an enlarged municipal plant or from the Toledo & Chicago Interurban power house. Manager Minton, of the electric company, has now agreed to furnish energy at a flat rate of 2.25 cents per kw-hour delivered at the plant, making a minimum of $175 per month.

LINTON, IND.—It is stated that the Indiana Steel & Iron Company, which was recently incorporated with a capital stock of $100,000, will construct and equip a water-works, electric-light and power plant, as well as remodel the old rolling mill for the manufacture of iron and steel. Pittsburgh (Pa.) capitalists are back of the enterprise, and the company promises great development in Greene County. W. J. Hamilton is resident director.

COUNCIL BLUFFS, IA.—The contract for lighting arrangements for the carnival to be held in this city the first week of September, involving the placing of approximately 3500 16-cp incandescent lamps, has been awarded to the Damon Electric Company.

DOUDS LEANDO, IA.—Plans are being matured by the Des Moines River Power Company for the construction of two dams near Douds which will develop 2000 hp each. Contracts have been secured for practically all of the land between Keosauqua and the proposed Douds dams, and the citizens of the latter city are said to look with favor upon the proposition. Should the required consents for the construction of the dams not be obtained, however, it is said that a site will be secured below Keosauqua.

FT. DODGE, IA.—It is understood that the citizens of Ft. Dodge have voted against the issuance of $125,000 of bonds for the construction of a hydroelectric power plant and water filtration system.

GREENSBURG, KAN.—The contract for building the power house for the electric lighting company at this city has been awarded to J. G. Hewitt.

LECOMPTON, KAN.—A special election has been called by the Mayor of Lecompton for the purpose of voting on a $2,500 bond issue, the proceeds to be utilized for the installation of an up-to-date lighting system.

O'BANNON, KY.—The O'Bannon Improvement Club is reported formed at this place to promote a new electric-lighting, cold-storage and refrigerating company. It is proposed to purchase the old power house of the Louisville & Eastern Railway Company at Marcia, Ky.

OWENSBORO, KY.—At a recent meeting of the City Council plans were approved for the enlargement of the municipal electric-light plant. It is stated that several thousand dollars will be spent on the proposed improvements.

SHREVEPORT, LA.—The Council on Aug. 9 passed on second reading the ordinance accepting the local electric-light company's offer to give street lighting service for six years at $62.50 per lamp. With the ordinance is a provision that the city shall have the right to purchase the street-lighting system of the present company at its appraised value after the end of the six years, providing the city also acquires the water-works plant.

BINGHAM, MAINE.—A new electric-lighting system, which will supply an all-night service, is being installed in Bingham by the Maine Central Railroad Company.

BALTIMORE, MD.—An application has been filed by the Consolidated Gas, Electric Light & Power Company for permission to erect a generator plant at Heath and Leadenhall Streets, the estimated cost of which is placed at $16,000.

CHICOPEE, MASS.—On account of inability to take care of its present contracts to furnish service to local industries, the electric-light committee has petitioned the Board of Aldermen to authorize an $80,000 bond issue, the proceeds to be used for the enlargement and improvement of the municipal electric-light plant. The members of the electric-light committee are Dennis Murphy, chairman; C. H. Jenness and Adolphe Nantais.

EASTHAMTON, MASS.—The State Gas and Electric Light Commission has granted the application of the Easthamton Gas & Electric Light Company for permission to issue additional bonds of $100,000, the proceeds to be used to liquidate the company's indebtedness and to complete construction work at the Mount Tom plant.

FALL RIVER, MASS.—Permission has been granted to the Tiverton Electric Light Company, Tiverton, R. I., to extend its transmission lines in Fall River.

GREENFIELD, MASS.—The County Commissioners have approved the plans of David B. Carse, of New York, for the construction of a dam of reinforced concrete 64 ft. in height on the Deerfield River, about a mile below the Gardner Falls dam of the Greenfield Electric Light & Power Company. The commissioners approval is subject to the condition that the Carse plans and specifications be made to comply with certain recommendations of Engineer J. L. Tighe, of Holyoke, calling for reinforcement of the dam proper.

LAWRENCE, MASS.—The Water Board of this city will receive bids until 3 p. m., Aug. 23, for a turbine-driven centrifugal pump and condenser for handling 3,000,000 gal. in twenty-four hours. J. F. McCarty is president of the board, and Morris Knowles consulting engineer.

LEE, MASS.—The Smith Paper Company is erecting a large brick structure south of the Columbia mill, it being the company's intention, according to newspaper reports, to use it as a power station in connection with the electrification of its mills.

MANSFIELD, MASS.—The property of the Massachusetts Coal & Power Company, of this city, has been sold by order of the receiver, Irvin McD. Garfield, to Joseph A. Haley, representing a syndicate, for $10,400. The plant consists of 1700 acres of land and buildings, and leases in mining rights on about 400 acres of land.

MEDFORD, MASS.—In order to expedite the operation of the locks at the recently constructed dam at Cradock Bridge, Medford, the Park Commission has ordered the installation of electric motors to replace the present hand machines.

NORTH EASTON, MASS.—The Edison Electric Illuminating Company, of Brocton, is planning to extend its transmission lines to North Easton, an application for permission to erect poles and string wires on the principal streets of the town having been filed wtih the Selectmen.

PEABODY, MASS.—At a recent meeting of the finance committee of Peabody, an appropriation of $2,000 was recommended for the extension of the municipal electric-light plant, the original request for $3,000 being denied.

HANCOCK, MICH.—The city of Hancock, which receives its lighting service from the Houghton County Electric Light Company, is considering the advisability of installing a municipally owned plant. It is estimated that an expenditure of about $15,000 would be required to install the generating equipment, irrespective of the poles, wires and other apparatus. The city's contract with the Houghton County Company expires next year.

ISHPEMING, MICH.—It is the intention of the city officials to expend $15,000 in overhauling the municipal electric-light plant. The transmission lines of the company are to be extended from the power plant to the Cleveland-Cliffs Iron Company's plant at the Maas mine, arrangements having been made with the company to furnish the city's patrons with light whenever the municipal plant is out of commission.

LAPEER, MICH.—We are advised by C. D. Hulbert, superintendent of the Lapeer Gas-Electric Company, that the company is in the market for a 200-hp boiler, 150-lb. pressure.

MANISTEE, MICH.—A franchise to furnish electrical energy in this city has been granted to the Manistee County Electric Company, and work will be commenced within three months on the construction of its first dam over the south branch of the Manistee River.

BROWN'S VALLEY, MINN.—The contract for the construction of the electric light plant at this city has been awarded to the Minneapolis Steel & Machinery Company, of Minneapolis, for $10,950. Charles L. Pillsbury, Minneapolis, is engineer.

CANBY, MINN.—E. W. Erick, M. O'Toole and Fred Schult, of South St. Paul, have secured a franchise for the installation of an electric-light, heat and power plant at Canby.

DULUTH, MINN.—Plans are being considered by the West End Commercial Club for the installation of an improved system of lighting on Superior Street, the estimated cost being about $3,500.

DULUTH, MINN.—It is announced that the Zenith Telephone Company had decided to postpone its contemplated improvements, including the erection of a new $20,000 building at the West End.

EVELETH, MINN.—Bids for the purchase of a franchise for constructing and operating an electric line through Eveleth, to be part of an interurban line to run between Hibbing and Gilbert, have been advertised for by the city clerk.

MINNEAPOLIS, MINN.—The following are reported to be the bids for (a) engine and (b) generator for use in connection with the proposed electrical plant at the city crematory, or (c) total cost: Northwest Electrical Company, (a) $9,732, (b) $10,173, (c) $44,506; Electric Machinery Company, (b) $8,279; Minneapolis Steel & Machinery Company, (a) $8,786, (b) $9,475; Allis-Chalmers Company, (c) $20,427; R. B. Whittaker, (c) $17,991; Electric Machinery Company and Frank Cook, $17,550 and $18,350, respectively, on a pole line; the Electric Machinery Company, $1,941 on a switchboard, and the General Electric Company, $21,984 on generators, lamps, switchboard and all electrical equipment.

TOWER, MINN.—By a vote of ninety-two to eight the city of Tower voted on Aug. 7 in favor of an $18,000 bond issue, the proceeds to be

used for the construction of a dam and electric-light plant at Pike River, 6 miles from the city, from which point electrical energy will be supplied to Tower.

WABASHA, MINN.—It is reported that the Minnesota-Wisconsin Power Company, of Menominee, Wis., will construct a 66,000-volt transmission line to Wabasha.

CLARKSDALE, MISS.—H. S. Boles, City Engineer, writes that bids will be received Sept. 5 for the extension and improvement of the water works, sewers and electric-lighting system, the probable cost of such improvements being in the neighborhood of $55,000.

FORSYTH, MO.—A petition is being circulated in Taney County by Attorney C. H. Grooms, of Forsyth, under the direction of Gen. William H. Standish, to secure permission from property owners to divert the waters of the White River from a portion of land 10 miles below Forsyth, the object being to construct a second dam at that point. General Standish is interested in the James River dam proposition, and it is possible that work on the first project will not be carried out until after the White River dam is built.

KANSAS CITY, MO.—We are advised by Louis H. Egan, general manager of the Kansas City Electric Light Company, Kansas City, Mo., that to the best of his knowledge and belief the city has no intention of installing a municipal electric-light plant. Our item in the issue of August 5 should have read Kansas City, Kan., instead of Kansas City, Mo.

ST. LOUIS, MO.—The St. Louis & Jennings Railway Company has applied to the County Court of Slayton for a franchise to construct an electric railway from the western limits of the city to the Jennings Station Road.

CHOUTEAU, MONT.—The local electric-light plant, which was acquired two years ago at a sheriff's sale by Julius Hirchberg, has been sold to H. McCullough, of Corbin, Mont. It is the intention of the new owner to put the plant in first-class condition so as to be able to furnish lighting service by Sept. 1.

BRAINARD, NEB.—The contract for installing a water-works system and erecting the electric-light plant of Brainard has been awarded to the Almo Engine & Supply Company, Omaha, Neb., for $10,713.

CURTIS, NEB.—Plans are being completed for the installation of a municipal electric-light plant at this city. Charles F. Sturtevant, civil engineer, is in charge of the work.

LINCOLN, NEB.—As the result of a fire at this city the lighting plant was put out of service. No damage, it is stated, was done to the pumping machinery.

OMAHA, NEB.—Application for permission to construct an electric railway from Sioux City to Omaha has been made by the Omaha, Sioux City and Northern Railway Company.

OMAHA, NEB.—The portable power plant used as the south-side substation of the street railway company, and which was used for distributing energy to the Manawa line, was destroyed by fire during a recent electrical storm, the damage, almost wholly to machinery, being estimated at $18,000.

WYMORE, NEB.—F. W. Weeks, City Clerk, writes that the contract for constructing 10 miles of street lighting lines (bids opened Aug. 9) has been awarded to the Columbian Electrical Company, of St. Joseph, for $8,303.

ELY, NEV.—Newspaper reports state that a large power plant is shortly to be erected on Cleve Creek by the Telluride Power Company, of Provo, Utah.

JARBIDGE, NEV.—An electric-light and power plant is to be installed at the new camp of Jarbidge, for the operation of the mines and mills. A company capitalized at $100,000 has been organized by Gilmore Kinney, Jr., J. M. Kinney, J. T. Brunn and George F. Elliott, all of Jarbidge.

MANCHESTER, N. H.—In order to furnish the energy lacking because of the low-water conditions, the Amoskeag Manufacturing Company expects to install a 5000-kw generator at its large plant. It is stated that a number of additional motors will also be installed.

MEREDITH, N. H.—The transmission lines of the Meredith Electric Light Company are being extended along Lang Street.

BLOOMFIELD, N. J.—Engineers Runyon & Carey, of Newark, N. J., in a report to the Town Council on Aug. 7 recommended the construction of a municipal street-lighting system which would also provide for a commercial service.

JERSEY CITY, N. J.—It is quite probable that an improved lighting system will be installed on Newark Avenue, from Warren Street to Coles Street, the shopping district, a committee representing the Business Men's Association of Jersey City having requested the Mayor to authorize an appropriation for this purpose.

TRENTON, N. J.—The Board of Public Utility Commissioners has given its approval to the revised plan for the consolidation of the Bernards Electric Company, the Warren County Power Company and the Eastern Pennsylvania Power Company. Under the new plan the Bernards Water Company, Bernardsville, N. J., is to sell to the Bernards Electric Company all of its real and personal property, constituting its electric light and ice plants, for $125,000. The electric company, after purchasing the property, is to issue bonds to the water company in the sum of $125,000. The bonds are to be secured by a mortgage. The next step will be the sale and conveyance of the electric company's property to the Eastern Pennsylvania Power Company, which in turn will lease the property to the electric company. The power company is to acquire $1,000 of the capital stock of the electric company for cash at par, and this stock is to be mortgaged to the Commercial Trust Company, of Philadelphia. Approval of this plan was given subject to the restriction that no extensions or betterments should be made to the property of any of the companies without first obtaining the approval of the Board.

ENGLE, N. M.—The Secretary of the Interior, Washington, D. C., has awarded the contract to the Lidgerwood Manufacturing Company, of New York, for furnishing three cableways for use in the construction of the Engle Dam, Rio Grande Irrigation project, New Mexico. These cableways each have a span of 1420 ft. and are to be electrically operated.

KELLY, N. M.—A small electric light and power plant is to be installed at the Germany mine in this place.

TUCUMCARI, N. M.—R. G. Lafite, who recently took over the local electric-light plant and organized a company known as the Tucumcari Light & Power Company, is planning many improvements in the system. A new powerhouse is to be erected in which new generators and boilers will be installed, the transmission lines of the company extended through the residential district and an all-day service provided for the operation of electric motors. The voltage of the system will be changed from 220 volts to 110 volts.

BROOKLYN, N. Y.—Bids will be received by C. B. Snyder, Superintendent of School Buildings, until Aug. 21 (readvertisement) for the installation of electrical equipment in the Washington Irving High School, Borough of Manhattan.

COMSTOCK, N. Y.—Bids will be received by Joseph F. Scott, Superintendent State Prisons, Capitol Building, Albany, N. Y., until Aug. 31 for construction, including heating, plumbing and electric work for cage, connecting corridors, laundry and bath houses, mess hall and kitchen building, power house, punishment prison and conduits, including power plant at Great Meadow Prison, Comstock. Franklin B. Ware, Albany, is the state architect.

JAMESTOWN, N. Y.—The Odsonia Worsted Mills is installing a 1000-hp steam turbine engine and two additional tubular boilers.

LOCKPORT, N. Y.—A mortgage for $25,000,000, given by the Federal Telephone Company to the Trust Company of America, of New York, has been recorded in the Western New York counties in which the properties of the telephone company which secures it are located. This is said to be the final step in the recent acquirement by the Federal company of a large number of independent companies west of Syracuse, including Niagara Falls, North Tonawanda, Lockport, Middleport, Gasport, Sanborn, Medina and other places.

NAPLES, N. Y.—We are advised by Edward L. Bailey, of the Dundee Electric Lighting Plant, that he has made application to the Public Service Commission of New York to exercise and enjoy a franchise granted by the Village Board of Naples, Ontario County, N. Y., to erect poles and string wires for the purpose of supplying electric service for fifty years. The system will be 60-cycle.

WATERTOWN, N. Y.—Plans are being perfected by the Empsall Department Store to install its own electric system. The plant will be located in the new Anthony Street addition which the company is erecting, and will cost in the neighborhood of $3,500.

GREENSBORO, N. C.—On account of the shortage of water at its dams, the Southern Power Company has made temporary arrangements with the White Oak cotton mill, which operates a 10,000-hp plant, to supply electrical energy to several North Carolina cities.

MOTT, N. D.—The North Dakota Independent Telephone Company is constructing a telephone line from this city to Bismark.

BEACH CITY, OHIO.—It is the intention of the citizens of Beach City to construct a 26-mile electric railway from Beach City to Millersburg by way of Winesburg, Mount Hope and Berlin.

CINCINNATI, OHIO.—The Ohio Valley Electric Railway Company, of Cincinnati, contemplates the erection of an addition to its power house at Kenova, W. Va.

COLUMBUS, OHIO.—Bids will be received until Aug. 22 by H. S. Holton, Director Public Service, for furnishing and installing a cluster lighting system on Dublin Avenue, also at the same time a separate bid for 866 ornamental standards.

KENTON, OHIO.—Bids were opened Aug. 3 for pumping machinery, etc., and a contract for a 65-hp engine was awarded to the Brownell Company, of Dayton, and a 40-kva generator to the Ft. Wayne Electric Company. The contract for pumps has not yet been let. Charles Brossman, Union Trust Building, Indianapolis, Ind., is the consulting engineer.

NORTH LIMA, OHIO.—A fire of unknown origin totally destroyed the freight and passenger depot, as well as the substation, of the Youngstown & Southern Railway Company, of Youngstown, Ohio. The loss in electrical machinery alone, exclusive of the buildings, is stated to be in the neighborhood of $25,000. It is understood that the power house will not be rebuilt at North Lima, but that, if a new structure is erected, it will be located at Columbiana.

SHARON, OHIO.—The City Council has under consideration the establishment of a municipal electric-light plant. Estimates are being secured on the cost of erecting such a plant and on the cost of mainte-

nance, and it is believed that active steps will be taken at an early date looking toward the installation of an up-to-date system.

WORCESTER, OHIO.—A $10,000 plant is to be installed at the Experiment Station, bids for which, it is announced, will not be advertised.

OKLAHOMA CITY, OKLA.—The reorganization of the Oklahoma-Shawnee Interurban Railway Company has been effected, and a charter asked for in the name of the Oklahoma-Shawnee Railway Company. The new concern is to be capitalized at $3,000,000, and proposes to construct an electric line 100 miles in length, the work to be commenced within the next few months. L. E. Patterson is president of the company. The line is to be affiliated with the Oklahoma City Traction Company, of which Mr. Patterson is also president. While the line is to be electrically operated, the company in its articles of incorporation reserves the right to operate by steam if necessary. It also reserves the right to operate a telegraph and telephone system and electric plants in the various towns through which the proposed electric line will run.

WAYNOKA, OKLA.—Bids were opened Aug. 1 for the construction of water works and an electric plant, and the contract has been awarded to the Oklahoma Engineering Company, of Oklahoma City, for $24,475. Other bidders were: N. S. Sherman Machine & Iron Works, $23,977; Kennedy & Fleming, $24,006, and Fletcher & Hultz, $27,781.

MILTON, ORE.—The equipment of the Municipal Electric Light & Power Plant is to be increased from 260 hp to 560 hp, this action having been rendered necessary in order to meet the increasing demand for service.

PORTLAND, ORE.—Arrangements are being made by the Mt. Hood Railway & Power Company for the construction of a substation at the foot of Williams Avenue, the cost of which will be in the neighborhood of $60,000.

PORTLAND, ORE.—Plans have been matured by the Portland (Ore.) Railway, Light & Power Company for improvements that will represent an expenditure of $135,000. The work will include the installation of additional power-house equipment.

ROSEBURG, ORE.—The Oregon Gas & Electric Company is installing an electric plant at Roseburg, the cost of which, it is stated, will exceed $60,000.

PANAMA.—The only bid received and opened on Aug. 11 at the office of the Panama Canal Commission at Washington, D. C., for one 500-kw turbo-generator unit was submitted by the General Electric Company, of Schenectady, N. Y., at $26,623, if delivered in ninety days, or $24,143 in 160 days.

GETTYSBURG, PA.—Preliminary steps toward the organization of a competing electric-lighting company in this city are said to have been taken, and it is understood that a charter will be applied for at an early date. The new company, the promoters of which are all citizens of the town, is to be known as the People's Light Company of Gettysburg, and it is planned to interest as many local people as possible in the enterprise. The names of those directly responsible for the proposed company have not as yet been made known, but it is understood that representatives of the company have already been securing prices on machinery and equipment.

LEWISBURG, PA.—On account of the proposed merger of the electric-lighting plants of Sunbury, Northumberland, Milton and Lewisburg, the stockholders of the newly organized Citizens' Company of Lewisburg have decided to increase the capital stock of the company from $15,000 to $40,000, with the intention of constructing at once an up-to-date electric-light plant. It is estimated that about $30,000 will be expended by the company in the construction of this plant.

PHILADELPHIA, PA.—Bids will be received until Aug. 25 by James F. Hasskarl, Acting Director Department of Wharves, Docks and Ferries, for electric freight elevators for the Vine Street pier.

SCRANTON, PA.—A private lighting and heating plant, with an equipment for 200 arc lamps and an equal number of incandescent lamps, power to operate elevators and cash systems, and that will supply heat for the five-story building of the Globe Warehouse, of Scranton, is to be installed by that company. All of the heat and electricity used in the new building is to be produced in the company's plant.

EDGEFIELD, S. C.—We are advised by F. M. Boyd, owner of the electric-lighting plant at Johnston, S. C., that, owing to some slight technicalities in the election, the town of Edgefield will be compelled to have another election on the question of issuing bonds for the establishment of an electric-light plant.

JOHNSTON, S. C.—According to advices received from F. M. Boyd, owner of the electric-light plant at this city, a bond issue for a water-works system is to be voted on very shortly, and should the election carry the water works will be operated in connection with the electric-light plant.

SIOUX FALLS, S. D.—The Bennett Light & Power Company, which derives its energy from the waters of the Big Sioux River and is one of the two great hydroelectric plants in Sioux Falls, has been acquired by Frank Thompson, of St. Paul, the purchase price being $80,000.

GREENVILLE, TENN.—W. T. Mitchell, City Recorder, writes that the proposed water-works and electric-light plant will cost about $65,000. Bids not yet called for. W. S. Shields, of Greenville, is the engineer.

JOHNSON CITY, TENN.—The power plant of the Johnson City Traction Company is being enlarged. A new boiler room is being built and new boilers are to be installed. There is also some talk of connecting Johnson City with Jonesboro by an electric line, the improvements which are being made at the power plant enabling the traction company to furnish energy for its operation.

KNOXVILLE, TENN.—Application for permission to install a lighting system in this city has been filed by the Eastern Tennessee Power Company, of Parksville, and it is understood that the Ocoee Power Company will also ask for the same privilege.

BRENHAM, TEX.—A twenty-four-hour service is soon to be established by the electric lighting company of this city. New machinery is being installed and the system will be changed from 133 cycles, 1100 volts, to 60 cycles, 2200 volts.

DEL RIO, TEX.—The Del Rio Electric Light & Ice Plant has been sold to W. R. Payne, the consideration being $37,550.

FT. WORTH, TEX.—The Ft. Worth Southern Traction Company has received a franchise from the County Commissioners' Court to build an electric railway from Ft. Worth to Cleburne by way of Everman, Burleston and Joshua.

KENNEDY, TEX.—A franchise to install an electric-lighting system in Kennedy has been granted by the City Commissioners to J. D. Autry and D. D. McAda.

FARMINGTON, UTAH.—Representatives of Farmington, Kaysville and Bountiful are considering a proposition to purchase the electric light plant of the Davis County Power Company, which went into the hands of a receiver about a month ago, it being believed that the property can now be obtained for half of its original value of $150,000. The Davis County Company has been furnishing energy for lighting the streets in Kaysville and Farmington, and it is planned, if the deal is consummated, to make the plant a municipal station for the three above-mentioned towns.

OGDEN, UTAH.—The Davis & Weber Counties Canal Company will let a contract about Aug. 31 for the construction of its proposed hydro-electric plant at Riverdale; it is reported that the contract for the excavation and concrete was let on Aug. 12.

PARK CITY, UTAH.—Pending the hearing of a suit to decide its right to occupy a piece of land owned by N. J. Hansen, P. A. Sorenson and W. Richards, in Parley's Canyon, Judge M. L. Ritchie has granted to the Knight Power Company the right to construct a high-tension transmission line from its plant on the Provo River in Wasatch County to its plant at the mouth of East Mill Creek, the proposed construction of which has been previously mentioned. The company has been required to give a $500 bond to guarantee the defendants against damage.

NORTH TROY, VT.—The Frontier Electric Company, which was recently organized with a capital stock of $30,000, is to construct a generating plant for the distribution of energy at a point about two miles south of North Troy. Water rights have been secured, and a concrete dam is to be erected west of the Duboise bridge, which, it is estimated, will develop 800 hp for ten hours a day and 200 hp for the remainder of the day. The Frontier Company has purchased the plant and lighting system of the North Troy Electric Light & Power Company, and upon completion of the new plant the two systems will be interconnected.

GRANDVIEW, WASH.—A fifty-year franchise to supply electrical energy in this city has been granted to the Pacific Power & Light Company, of Portland, Ore., and it is expected that a lighting system will be installed inside of sixty days.

HILLYARD, WASH.—On account of dissatisfaction over the rates charged by the Washington Water Power Company, the citizens of Hillyard are considering the installation of a municipal plant, a committee composed of Messrs. J. F. McGinnis, A. M. Murray, Jesse Jones, H. R. Jones, J. E. Barr and others having been appointed to look into the matter.

MOUNT VERNON, WASH.—An application has been filed by the Nooksack Valley Traction Company for permission to build an electric railway through Mount Vernon.

SOUTH BEND, WASH.—Among the improvements planned by the Twin City Power & Electric Company are the construction of an electric line from South Bend to Raymond and the erection of a new substation midway between the two cities.

SPOKANE, WASH.—The International Power & Manufacturing Company has filed articles of incorporation and proposes to construct a dam across the Spokane River at the site of the new paper mill at Millwood, from which electrical energy will be furnished to manufacturing concerns in the immediate vicinity for the operation of lamps and motors. The capital stock of the company is placed at $250,000, and the incorporators are: W. S. Yearsley and Martin H. Gerry, Jr.

STEVENSON, WASH.—E. P. Ash and S. Samson have made arrangements to file claims on Wind River, about 18 miles northwest of Stevenson. Their intention is to organize a company to be known as the Cleom Tumwater Light & Power Company, capitalized at $250,000, the greater number of shares to be held by themselves. Mr. Stevenson is the owner of the Skamania Light & Power Company, of Skamania, and is at present furnishing energy for lamps and motors in that city and Carson. It is expected that 6000 hp can be developed at the falls on Wind River without a dam, and that with a dam the power can be doubled or trebled.

VANCOUVER, WASH.—The Portland Railway, Light & Power Com-

pany, Portland, Ore., has abandoned the idea of establishing a new steam-power plant at Vancouver,, and instead will erect a substation, electrical energy being supplied from its Portland plant through two new cables which will be laid under the river. Two new transformers, additional switches and other necessary apparatus will be installed in the new station.

WHITE BLUFFS, WASH.—The Pacific Power & Light Company is planning to expend between $6,000,000 and $10,000,000 in the development of hydroelectric power on the Columbia River at Priest Rapids, near White Bluffs. The improvements include the erection of a dam 85 ft. in height at the Rapids and the construction of transmission lines which will supply electrical energy to a large section of eastern Washington.

MORGANTOWN, W. VA.—The National Power Company, of Pittsburgh, has been granted a charter under the laws of West Virginia. The company proposes to build a scenic electric railway from Point Marion up Cheat River for several miles. The incorporators are: F. B. Parriott, W. B. Beecher, E. J. Cole, W. H. Young and S. B. Kelly, all of Pittsburgh, Pa.

JANESVILLE, WIS.—The city is planning to install a street-lighting system similar to that employed at Des Moines, Ia., an investigation of this system having been placed in the hands of the Janesville Commercial Club.

MENASHA, WIS.—The total amount of the contracts awarded for the municipal electric plant at this city was $18,000, and not $8,000 as stated in a previous issue.

MENDOTA, WIS.—The contract for the construction of the new power house for the State hospital at Mendota has been awarded to T. C. McCarthy, of Madison, for $38,850.

NEW LISBON, WIS.—W. A. Sargent, City Clerk, will receive bids until Aug. 23 (readvertisement) for constructing an electric-light plant and water works. Aug. H. Meyer, Appleton, Wis., is the engineer.

STOUGHTON, WIS.—The City Council has approved final plans for the installation of a municipal lighting system, and a power house is to be erected at a cost of $6,000 at the city mill dam.

LARAMIE, WYO.—Advices have been received from the Laramie Electric Company, A. E. Anderson, superintendent, that contracts have been let for extensive improvements in its plant, including the installation of a water-tube boiler, non-releasing Corliss engine-driven, three-phase alternator and an entirely new switchboard. A tank and all appurtenances for a steam-heating system for the business district is also to be installed.

KAMLOOPS, B. C., CAN.—It is stated that the municipality of Kamloops will expend $200,000 in the development of a hydroelectric plant at Barrier River.

REVELSTOKE, B. C., CAN.—The contract for constructing the second flume at the power plant has been awarded to the Pacific Coast Pipe Company, of Vancouver, for $7,425.

PORTAGE LA PRAIRIE, MANITOBA, CAN.—The city's offer of $110,000 for the plant of the General Electric & Gas Company, mention of which was recently made in these columns, has been accepted by the company.

THAMESFORD, ONT., CAN.—At a recent meeting of the citizens of this city and the surrounding district, including Kintore, final action was taken on the proposition to utilize hydroelectric service in and about Thamesford, the voting having been unanimous in favor of the adoption of such a system.

MONTREAL, QUEBEC, CAN.—At a recent meeting of the directors of the Porcupine Gold Mines Company, held at its offices, 47 West Thirty-fourth Street, New York, the plans and specifications for a new mill and power plant submitted by C. H. Porrier, the manager, were approved, and orders for machinery will be placed at once. The new plant will have a rated output of 100 tons per day.

OAXACA, MEXICO.—It is reported that Jose Vasconcelos, of Mexico City, representing a syndicate of Americans, has applied to the City Council of Oaxaca for a franchise to install an electric-light and power plant in the latter city. It is the purpose of the syndicate to construct transmission lines to many of the towns and mining camps of the state and provide them and the various industries with electrical energy.

New Industrial Companies.

AMERICAN NIEUPORT AEROPLANE COMPANY, New York, N. Y., has filed articles of incorporation, and expects to manufacture and deal in aerial machines. It is capitalized at $50,000, and the incorporators are: A. A. Ryan, I. V. McGlone, K. R. Howard, W. J. Reed, all of 32 Liberty Street, New York.

THE AMERICAN LIGHTING COMPANY, Camden, N. J., has been incorporated to manufacture incandescent lamps, gas burners, etc. It is capitalized at $25,000, and the incorporators are: E. R. Hansell, G. H. B. Martin and J. A. MacPeak, all of Camden.

THE AUTO-ELECTRIC COMPANY, Mobile Ala., has applied for a charter to do general electrical work. It has an authorized capital of $10,000, and those responsible for its formation are E. B. Walzl, W. B. Royster, A. C. Carroll, A. C. McClellan and F. Geddings.

NEWTON A. K. BUGBEE & COMPANY, Trenton, N. J., have filed articles of incorporation for the purpose of conducting a general contracting, engineering and construction business. The authorized capital of the concern is placed at $100,000, and the incorporators are: N. A. K. Bugbee, H. W. Bradley and E. H. Bugbee, all of Trenton.

CALIFORNIA INCANDESCENT LAMP COMPANY, Los Angeles, Cal., has been incorporated with a capital stock of $100,000 by H. P. Oates, J. E. Bowen, B. B. Lady, O. O. Clark and W. S. Davis.

THE ELECTRIC EQUIPMENT COMPANY, Springfield, Mo., capitalized at $10,000, has been incorporated by H. F. Ford, J. T. Coon and W. A. Coon.

THE ELECTRICAL CONSTRUCTION & SUPPLY COMPANY, of New Bedford, Mass., has been incorporated with a capital stock of $10,000. The incorporators are: Ernest L. Howe and Sylvanus P. Dawes.

THE G. & E. FONDEN ROCK DRILL COMPANY, Philadelphia, Pa., has been incorporated with a capital stock of $500,000 to manufacture electric rock drills. The incorporators are: B. F. Harpel, Topton, Pa.; C. A. Smith, Chester, Pa., and T. Thompsen, Philadelphia, Pa.

THE IGNITION MANUFACTURING COMPANY, Newark, N. J., has been incorporated with a capital stock of $100,000 by P. G. Roder, A. Markowsky and W. L. Roder, all of Newark. The new concern proposes to manufacture automobiles, motor vehicles, supplies, etc.

THE INTERNATIONAL SANITARY TELEPHONE COMPANY, New York, N. Y., has filed articles of incorporation. It is capitalized at $50,000, and the incorporators are: A. L. Carter, 60 Wall Street, New York; I. A. Edelstein, 61 E. 112th Street, New York, and C. D. Cruikshank, 498 Westminster Road, Brooklyn, N. Y.

THE IRIS AEROPLANE COMPANY, New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture and deal in aeroplanes. The incorporators are G. H. Godley, C. D. Jarvis, New York City; S. S. Godley, Cincinnati, Ohio.

New Incorporations.

MOLINE, ALA.—Articles of incorporation have been filed by the Moline (Ala.) West Shore Traction Company. The new concern, which is capitalized at $10,000, proposes to construct an electric railway from Moline to Alabama Port, near the west shore of Mobile Bay. The officers of the company are: H. Austell, president; J. N. McAleer, vice-president; E. E. Posey, secretary and treasurer.

SACRAMENTO, CAL.—The North Sacramento Light & Water Company has filed articles of incorporation, and the following directors have been elected: Marshall Diggs, R. C. Waring and M. N. Williamson, of Sacramento; D. W. Johnston, of Los Altos; G. A. Richards, of Placerville; C. E. Hollister and J. T. Elliott, of Courtland. The company has an authorized capital stock of $50,000.

SAN BERNARDINO, CAL.—The Sierras Construction Company and the Southern Sierras Power Company have filed incorporation papers, the capitalization in each instance being $5,000,000, and the incorporators of each company are: Delos A. Chappell, Lawrence C. Phipps, Charles F. Potter, G. S. Wood, T. S. Hayden and W. E. Porter. These are the enterprises that are behind the various moves for franchises that have been asked for by F. A. Worthley, of Riverside.

GARNER, N. C.—The Garner Telephone & Telegraph Company, capitalized at $10,000, has been incorporated by J. T. Wrenn, McCullers; H. Bryan, Garner; C. U. Harris, Raleigh.

MIDDLETOWN, OHIO.—At a special meeting of the City Council an ordinance was passed providing for the installation of cluster lamps on Third Street, between Canal Street and Curtis Avenue, a distance of about 700 ft. on each side of the street.

DENVER, PA.—Articles of incorporation have been filed by the Denver Electric Light & Power Company. It has an authorized capital stock of $5,000, and the incorporators are J. W. Moore, Monroe Lebo, Sheridan; Robert Immell, Oscar Witter, James Cherington, Dr. J. H. Horn, J. F. Mattis, A. Fisher, N. P. Coldren, Newmantown; D. S. Martin, Bellevue, and A. W. Marberger, Denver.

CAMDEN, S. C.—A charter has been granted to the Camden Water & Light Company, of Camden, by the Secretary of State. The company, which has a capital stock of $70,000, proposes to do a general electric-service business, and the incorporators are: J. T. Harrington, Youngstown, Ohio; E. C. Brainard, Chicago; R. E. Cornelius, Youngstown, and W. M. Shannon and H. G. Garrison, both of Camden.

SIOUX FALLS, S. D.—It is announced that H. M. Byllesby & Company, engineers and managers of public utilities, 206 La Salle Street, Chicago, Ill., have purchased the plant of the Sioux Falls Light & Power Company, of Sioux Falls, S. D. This company owns and operates a hydroelectric generating plant on the Big Sioux River, reinforced by a modern steam auxiliary station, and serves the greater part of Sioux Falls with energy for lighting, transportation and industrial purposes. Formal possession will be taken in a few days, with N. C. Draper, formerly of Zanesville, Ohio, as manager. Improvements and extensions will be made to the property.

WEST POINT, VA.—A charter has been granted to the People's Light, Heat & Power Company, West Point, Va. The maximum capital is placed at $25,000, minimum capital, $5,000. The following officers have been

elected: J. R. McRae, president; Crosby Thompson, vice-president; A. J. Bagby, secretary; H. R. Topping, treasurer, all of West Point.

SPOKANE, WASH.—The Bellingham, Mount Baker & Spokane Interurban Railway Company, capitalized at $25,500,000, has filed articles of incorporation.

Personal.

MR. C. F. BEAMS has resigned as manager of the Northern Ontario Light & Power Company, Cobalt, to accept the position of chief electrical engineer to the State of Mysore, India. Mr. Beams sailed from New York for his new post on Aug. 16.

MR. S. B. TUELL, formerly manager of the Key West (Fla.) Electric Company, has been appointed superintendent of the Pawtucket (R. I.) Electric Company to succeed Mr. Donald C. Barnes, who will assume charge of electrical and traction properties for Stone & Webster in the State of Washington.

MR. W. L. ARNOLD, of the Arnold Company, Chicago, accompanied by Mrs. Arnold, has sailed for Europe for an eight weeks' stay, following which he will proceed on a leisurely trip around the world, reaching San Francisco in February, 1912. Although Mr. Arnold is encircling the globe principally for recreation, he plans to investigate a number of matters of engineering interest in the countries he will visit.

MR. N. C. DRAPER, formerly superintendent of the Zanesville (Ohio) division of the Columbus, Newark & Zanesville Electric Railway, which supplies electric lighting for Zanesville, has been appointed manager of the Sioux Falls Light & Power Company, of Sioux Falls, S. D., which was recently acquired by H. M. Byllesby & Company, Chicago. Mr. Draper was for a time master mechanic for the Central Railway Company of Peoria, Ill., and later became superintendent of the Peoria and Pekin Terminal Railway. Before going to Zanesville, Mr. Draper was vice-president and general manager of the Eastern Wisconsin Railway and Light Company, of Fond du Lac, Wis.

Obituary.

MR. WILLIAM DUNLAP SARGENT, director of the New York & New Jersey Telephone Company, of which he acted as general manager when it was first formed, died at his summer home in Somerset, Pa., on Aug. 10, following a long illness. Mr. Sargent served as telegraph operator at General Burnside's headquarters during the Civil War. He was a member of the Telegraphers' Mutual Benefit Association and of the American Institute of Electrical Engineers. He was sixty-seven years old.

Trade Publications.

HYDRAULIC PUMPS.—The Watson-Stillman Company, 50 Church Street, New York, has issued Catalog No. 81, a new 120-page, 6 x 9 catalog, descriptive of many standard and several new types of hydraulic pumps. Useful information for hydraulic engineers and users of hydraulic machinery is also included.

AUTOMATIC CUT-OFF VALVE.—The Lagonda Mfg. Co., Springfield, O., has issued a circular relating to the Lagonda automatic cut-off valve, which is stated to be the only valve which has been admitted, up to date, to the Museum of Safety Devices in the Engineering Societies Building, 39 West 39th Street, New York. The valve is so made as to close automatically if a break occurs on either side of the valve. The circular described some tests made at Washington in January, 1909, in which a 4-in. valve was used, showing the reliability of the mechanism.

BUSINESS NOTES.

CHICAGO OFFICE OF JAEGER MINIATURE LAMP MFG. COMPANY.—A branch office of the Jaeger Miniature Lamp Mfg. Company of New York (Bible House) has just been opened at the Rand-McNally Building, 157-173 West Adams Street, Chicago, Ill. A full line of Jaeger miniature lamps, automobile lamps, novelty outfits and Christmas-tree outfits will be carried in stock at the Chicago wareroom, which is located in close proximity to the office.

GENERAL MOTORS COMPANY.—Mr. William Vaughan, chemist, of Arthur D. Little, Inc., chemists and engineers, Boston, has been detailed from that organization as an assistant in the new centralized testing department which has just been organized under its direction for the General Motors Company, Detroit, Mich. Mr. Vaughan brings to this work experience with Arthur D. Little, Inc., as well as with the Salem Iron Company and Union Iron & Steel Company, where he filled the position of chief chemist.

PULSOMETER COMPANY.—Mr. F. B. DeGress, for over ten years New York district manager of the Crocker-Wheeler Company, has resigned from that company to assume the position of general sales manager of the Pulsometer Company, 17 Battery Place, New York City. Besides looking after the sales end of the business, Mr. De Gress is also carrying on a series of experiments, with a view to improving certain features of the pulsometer in order to make it suitable for general pumping work in power plants, industrial establishments, etc.

CHICAGO OFFICE OF FEDERAL MINIATURE LAMP COMPANY.—A branch office of the Federal Miniature Lamp Company, 812 Hippodrome Building, Cleveland, Ohio, has been established at 301 Fort Dearborn Building, Chicago, Ill. The new office is in charge of Mr. Frederick S. Armstrong, brother of Mr. Walter R. Armstrong, general manager of the company, who has had about fifteen years' experience in the lamp business. The Chicago warerooms are located in the Cambridge Building, corner of Randolph and Fifth Avenue. More than 100,000 miniature lamps, embracing scores of different styles and types, are here carried in stock.

ESTERLINE DETROIT BRANCH OFFICE.—The Esterline Company, Lafayette, Ind., manufacturers of the Esterline graphic meters and the "Matchless" electric-light and ignition system, announces the appointment of Mr. Le Moyne L. Parkinson as district sales manager for the State of Michigan, with his office at Detroit. Mr. Parkinson leaves the Standard Underground Cable Company, Pittsburgh, Pa., with which he has been associated for the past five years in charge of the sales of underground cable for electrical purposes. He was graduated from Geneva College in 1895, and the same year entered the employ of the Beaver Valley Water Company, in whose employ he continued for eleven years as assistant general manager. He is also a graduate of Rand's Commercial College, and of a special course in electrical engineering at the Cosmopolitan University, New York City.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 8, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

999,728. TELEPHONE SYSTEM; P. B. Allen, Elyria, O. App. filed Nov. 29, 1909. A complete set of signals controlled for guiding the operators in making connections on a trunk circuit.

999,729. TELEPHONE SYSTEM; P. B. Allen, Elyria, O. App. filed Dec. 6, 1909. Trunking system. Apparatus for giving a distinctive signal to both the calling subscriber and the central station whenever the called line is already in use.

999,735. ELECTRIC-CIRCUIT-OPERATING DEVICE; E. S. Beck, Treichlers, Pa. App. filed Nov. 30, 1909. Two electrodes (one removable) in an electrolyte and a manually controlled switch for moving the removable electrode.

999,745. MECHANICAL MOVEMENT; T. S. C. Both, New York, N. Y. App. filed July 2, 1910. Electric lamp socket switch with rotary key and sliding cam and contacts.

999,746. MECHANICAL MOVEMENT; T. S. C. Both, New York, N. Y. App. filed July 2, 1910. Division from application 570,138. Electric lamp circuit rotary snap switch socket with laterally movable contacts.

999,749. METHOD OF FORMING COILS FOR ELECTRIC APPARATUS; L. W. Chubb, Wilkinsburg, Pa. App. filed June 25, 1907. An aluminum strap is bent into coil form (edgewise) and immersed in a bath of sodium silicate and cement is pressed through. The convolutions are then pressed together.

999,754. ELECTRIC RAILWAYS; R. J. Dearborn, Edgewood Park, Pa. App. filed July 6, 1908. Lazy tongs support for a plurality of trolleys for two overhead conductors.

999,761. ARC LAMP; G. M. Dyott, Pittsburgh, Pa., and C. Carson, Wilkinsburg, Pa. App. filed April 28, 1906. Flaming arc lamp metallic oxid electrode. Means to remove the deposit from the metallic electrode.

999,762. STORAGE BATTERY AND PROCESS OF TREATING THE SAME; T. A. Edison, Llewellyn Park, N. J. App. filed March 20, 1908. Negative electrode of finely divided iron and mercury is immersed in trochloride of bismuth dissolved in acetone and then heated in caustic alkali.

999,772. COIL WINDING MACHINE; C. LeG. Fortescue Wilkinsburg, Pa. App. filed July 3, 1905. A folder for applying an insulating strip to a strap conductor for making transformer coils.

999,780. ELECTRIC FUSE AND FUSE HOLDER; F. W. Harris, Wilkinsburg, Pa. App. filed May 9, 1908. A U-shaped fuse member projects downwardly into a magnetizable member which quenches the arc formed upon rupture of the fuse.

999,781. MEANS FOR CONTROLLING ELECTRIC CIRCUITS; G. W. Hart, Hartford, Conn. App. filed Feb. 21, 1910. A single-winding magnet which can be energized whether the switch is open or closed but will be open-circuited by the subsequent action of the switch in either instance.

999,782. SWITCH; G. W. Hart, Hartford, Conn. App. filed July 7, 1910. Mechanically locked and released by the opening of a controlling circuit.

999,792. CONTROL SYSTEM; R. P. Jackson, Wilkinsburg, Pa. App. filed Jan. 5, 1907. Means for preventing simultaneous closure of two or more switches. (See No. 834,525.)

999,800. ELECTRICAL MEASURING INSTRUMENT; S. M. Kintner, Pittsburgh, Pa. App. filed Oct. 3, 1905. Electrostatic type. The

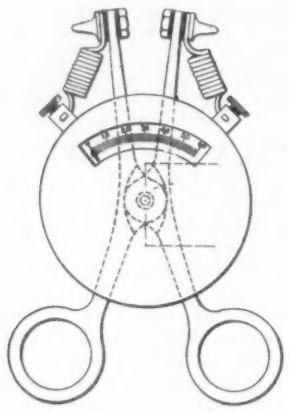
stationary and movable members with condensers are immersed in an insulating liquid under compression.

999,808. SWITCH; H. E. Leppert, New Britain, Conn. App. filed Oct. 19, 1910. Oscillating push button type; spring detent for the arm.

999,811. ELECTRIC GENERATOR, MOTOR, ETC.; B. Ljungström, Stockholm, Sweden. App. filed April 1, 1908. A mounting for the commutator independent of the rotating element but yieldingly connected thereto.

999,825. POLYPHASE TRANSFORMER; W. M. McConahey, Pittsburgh, Pa. App. filed Oct. 7, 1908. Laminated magnetizable end members interconnecting the ends of the core members.

999,833. ELECTROMAGNETIC GRAPPLING TOOL; C. G. Miller, Chicago, Ill. App. filed May 12, 1910. For picking up articles in a plating tank.



999,977. Volt and Ammeter.

999,851. ELECTRIC SWITCH; G. E. Palmer, Winchester, Mass. App. filed May 3, 1910. Electromagnetically controlled.

999,859. PORTABLE TELEPHONE; N. Pedersen, Genoa, Ill. App. filed June 4, 1909. Structural details of the standard.

999,870. ELECTRICAL APPARATUS; K. C. Randall, Edgewood Park, Pa. App. filed July 23, 1909. Dry air is supplied under pressure to a casing containing the parts.

999,875. PROTECTIVE DEVICE FOR ELECTRICAL CIRCUITS; G. B. Rosenblatt, Butte, Mont. App. filed April 4, 1906. The terminals are separated when the circuit is opened.

999,883. ELECTRIC SWITCH; F. Schneider and J. C. Dunfer, Cleveland, O. App. filed Dec. 8, 1910. For hand tools, such as drills.

999,893. WINDING COIL FOR DYNAMO ELECTRIC MACHINE; C. E. Skinner, Wilkinsburg, Pa. App. filed Oct. 7, 1908. A fireproof coil of conducting material separated by aluminum foil treated to produce an insulating coating.

999,927. TELEPHONE SYSTEM; H. G. Mosler, Chicago, Ill. App. filed July 16, 1906. The cut-off relay is actuated by current flowing over a portion of the talking circuit when a link conductor is connected with the spring jack.

999,928. ARMATURE WINDING FOR ELECTRIC MOTORS; J. E. Webster, Pittsburgh, Pa. App. filed June 19, 1905. The lengths of the end portions of the armature coils are unequal and adjacent groups of the longer end portions are displaced with respect to each other.

999,935. CONSTRUCTION OF ELECTRIC MOTORS AND DYNAMOS; C. E. Willey, Louisville, Ky. App. filed Nov. 16, 1910. The pole piece and frame have registering longitudinally arranged key-ways and a key for holding them together.

999,945. HAND ELECTRIFYING DEVICE; H. Aub, Munich, Germany. App. filed July 19, 1910. A head band with two adjustable electrodes.

999,947. MOTOR CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed Nov. 8, 1909. Set to start a motor and then automatically stop it after it has made any desired number of revolutions. For controlling the steering apparatus of ships, etc.

999,977. VOLTMETER AND AMMETER; H. Fish, Stamford, Conn. App. filed Sept. 6, 1910. Has handles and terminals for making temporary connections with the poles or binding screws of a battery or magneto.

999,987. APPARATUS FOR PRODUCING HIGH-FREQUENCY CURRENTS; R. Goldschmidt, Darmstadt, Germany. App. filed Aug. 26, 1908. For wireless telegraphy, etc.

999,994. ENGINE STOP; A. S. Hawks, Bethlehem, Pa. App. filed July 8, 1910. A switch operated by centrifugal force.

1,000,031. CONNECTOR; E. Mattman, Milwaukee, Wis. App. filed Sept. 13, 1909. A terminal with a stepped bored hole, the walls being cut to make them yielding.

1,000,034. TROLLEY HARP; J. S. Norton, Wilkes-Barre, Pa. App. filed Dec. 4, 1909. The wheel shaft is held in the frame by a spring pressed locking bolt.

1,000,043. PIPE CONNECTION FOR OUTLET BOXES; J. N. Scisna, Syracuse, N. Y. App. filed Nov. 4, 1909. A part of the threads is cut away to admit a larger pipe and a setscrew fronted to hold the pipe end.

1,000,052. ELECTRIC SWITCH; C. H. Thordarson, Chicago, Ill. App. filed June 27, 1910. For storage battery power equipment, etc. Solenoid plungers operate the switch arm.

1,000,061. DYNAMO-ELECTRIC MACHINE; R. B. Williamson, Norwood, O. App. filed Nov. 1, 1907. For rolling mill drive. The motor shaft has a limited endwise movement upon the breaking of the coupling in case of an overload.

1,000,066. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, O. App. filed Nov. 27, 1905. The cross connectors are so supported and insulated from each other as to avoid short circuits.

1,000,074. ELECTROMAGNETIC SWITCH; H. B. Collier, Prairie Grove, Ark. App. filed Sept. 14, 1908. For burglar alarms, etc.

1,000,077. TRANSMISSION SYSTEM; G. C. Cummings, Western Springs, and A. Wray, Chicago, Ill. App. filed March 3, 1909. For party line telephones, etc. Allows one party to select another party on his own line. (57 claims.)

1,000,078. SYSTEM FOR TRANSMITTING INTELLIGENCE; G. C. Cummings and J. A. Kick, Western Springs, Ill. App. filed June 16, 1909. Keys for selecting and modifying the current at the transmitting station. An electromagnetically operated typewriter at the receiving station.

1,000,116. TROLLEY; G. E. Palmer, Chicago, Ill. App. filed Jan. 14, 1911. The wheel is carried by a spring-pressed plunger.

1,000,123. SWITCHBOARD-CIRCUIT AND EXCHANGE APPARATUS FOR TELEPHONE; H. J. Roberts, Evanstown, Ill. App. filed Sept. 5, 1905. For selective party lines and individual lines with two systems of signals.

1,000,141. ELECTRICAL FITTING; H. C. Barber, North Haven, Conn. App. filed May 8, 1911. A rosette with strain relieving grooves and openings for the wires.

1,000,146. TEMPERATURE COMPENSATING DEVICE; W. H. Bristol, Waterbury, Conn. App. filed July 28, 1910. Improvements on 783,503 and 800,792. A perforated container with members inside having differential coefficients of expansion. For minute currents.

1,000,154. SAFETY APPARATUS FOR AMUSEMENT OR OTHER AUDITORIUMS; J. H. Crosier, Philadelphia, Pa. App. filed March 19, 1909. Automatically lights an auditorium and unlocks the doors upon occurrence of abnormal conditions, as when a moving-picture machine becomes deranged.

1,000,158. ELECTRIC SWITCH; W. E. Dow, Baintree, Mass. App. filed Aug. 6, 1909. A removable plug controls operation of the switch arm. For automobile ignition systems, etc.

1,000,161. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS; A. C. Eastwood, Cleveland, O. App. filed Feb. 8, 1910. For a series-wound motor for operating electric hoists without a mechanical brake. Changes from series to parallel.

1,000,183. ELECTRIC CEILING FAN; E. Marelli, Milan, Italy. App. filed March 23, 1908. The blades are attached to a combined casing and armature mounted on a stationary hollow shaft. For alternating current.

1,000,189. TROLLEY; A. Nash, Chicago, Ill. App. filed Aug. 15, 1910. Spring supported fork to prevent sparking and jumping.

1,000,217. MANUFACTURE OF STEEL; W. R. Walker and J. H. Gray, New York, N. Y. App. filed Sept. 19, 1908. An open-hearth charge is oxidized by flame and gases to remove carbon, silicon and phosphorus. The slag is removed near the end of the heat and fresh basic slag introduced. The gases and flame are then excluded, and the charge is electrically heated to deoxide and desulphurize the metal.

1,000,248. APPARATUS FOR SHORTENING ELECTRIC WAVES; C. Ferrari and M. Pizzuti, Naples, Italy. App. filed April 14, 1910. A combination of a self induction, a capacity and discharge gaps to protect electric installation from excessive accidental voltages.

1,000,294. ELECTROMAGNETIC VIBRATOR FOR LOCAL APPLICATION TO THE PERSON; A. Rosenberg, London, Eng. App. filed March 19, 1910. Mushroom-shaped casing having one end adapted to be inserted in the ear cavity. Solenoid vibrator.

1,000,300. TESTING INSTRUMENT; H. W. Secor, Trenton, N. J. App. filed Jan. 11, 1910. A base and casting with two electric lamps and connections for comparing lamps.

1,000,314. TELEGRAPHIC INSTRUMENT; J. A. Zundel, New York, N. Y. App. filed Dec. 7, 1910. Adjustable sounder lever.

1,000,320. MERCURY CONTACT BREAKER; L. Baumeister, Erlangen, Germany. App. filed Nov. 12, 1910. The heat of the spark when the contact is broken effects a rapid separation between the contact point and the mercury.

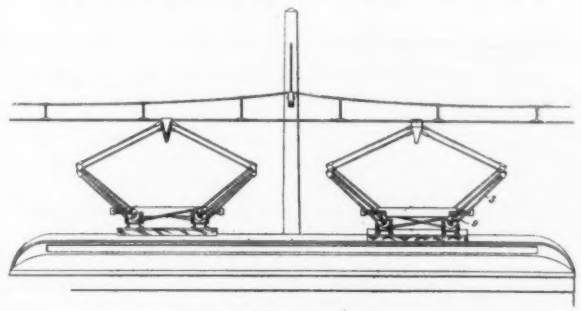
1,000,330. SECONDARY OR STORAGE BATTERY; N. Dodge, Philadelphia, Pa. App. filed June 9, 1904. The separator consists of a sheet of fine-grain wood.

1,000,342. TELEPHONE SYSTEM AND SIGNALLING APPARATUS; F. R. Parker, Chicago, Ill. App. filed Nov. 24, 1906. Supervisory signalling devices and a single signal device for both the line and supervisory signal.

PATENTS DELAYED IN RECEIPT.

994,114. June 6, 1911. MECHANICAL MOVEMENT; T. A. C. Both, New York, N. Y. App. filed Oct. 11, 1910. Details of key-type lamp socket.

996,620. July 4, 1911. ATTACHMENT PLUG; J. S. Crossley, Solvay, N. Y. App. filed Nov. 30, 1908. Spring locking means whereby the two parts may be easily connected together or disconnected.



999,754. Electric Railway.

996,844. July 4, 1911. FASTENING DEVICE FOR ELECTRICAL SIGN RECEPTACLES; E. H. Freeman, Trenton, N. J. App. filed April 1, 1910. The receptacle can be fastened in place wholly from one side of the sign board.

997,563. July 11, 1911. ROTARY SNAP SWITCH; S. Korf, Chicago, Ill. App. filed June 6, 1910. For use in key-type socket with chain pull.

997,588. July 11, 1911. LAMP SOCKET; E. E. Taylor and D. H. Elkins, Amesbury, Mass. App. filed Aug. 11, 1910. Provided with bayonet joint held in position by springs.

999,234. Aug. 1, 1911. ELECTRIC LAMP SOCKET; F. A. Lavercombe, Newport, Ky. App. filed July 23, 1909. Provided with anti-vibration support to minimize breakage of metallic filaments.